JAN 5 1922

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2721, Vol. 108] THURSDAY, DECEMBER 22, 1921 [PRICE ONE SHILLING

Registered as a Newspaper at the General Post Office.] [All Rights Reserved.

BALANCES & WEIGHTS

RESISTANCE COILS
P.O. BOXES

JOHN J. GRIFFIN & SONS,
Kemble St., Kingsway, London, W.C. 2

REYNOLDS & BRANSON, Ltd.

Chemical and Scientific Instrument Makers to His Majesty's Government (Home and Overseas Dominions), Laboratory Furnishers and Manufacturing Chemists.

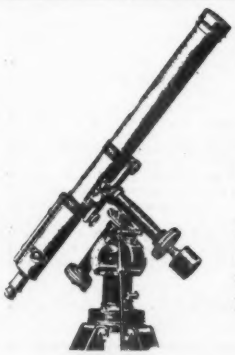
TANGENT GALVANOMETER, having mahogany frame and base with levelling screws, brass compass box, antiparallax mirror, and agate centred needle, with aluminium pointer. The coil has three windings of 2, 50, and 500 turns respectively, and can be revolved on the base to adjust the needle to the magnetic meridian.

PRICES AND PARTICULARS ON APPLICATION.

CHEMICAL, PHYSICAL, and TECHNICAL LABORATORIES fully equipped with Balances, Benches, Fume Chambers, Apparatus, Chemicals, A.R. Reagents, etc.

New Catalogue of Physical Apparatus on application.

14 COMMERCIAL STREET, LEEDS.



Telescopes for Astronomy

Particulars of Student, Alt-Azimuth & Equatorial Telescopes are given in our Price List "D.2."—free on request.

NEGRETTI & ZAMBRA
38, HOLBORN VIADUCT, E.C.1.
LONDON.

NOTICE

In consequence of the Christmas Holidays NATURE for December 29 will be published at 11 o'clock on **Friday morning, Dec. 30.**

ST. MARTIN'S STREET, LONDON, W.C. 2

UNION OF SOUTH AFRICA.

VACANCY FOR A MEDICAL OFFICER AND NATURALIST ON H.M. SLOOP *CROZIER* ENGAGED ON HYDROGRAPHIC SURVEY AND FISHERY RESEARCH WORK.

Applications are invited from qualified persons for the *combined* duties of the above-mentioned post.

Salary.—As for a Lieutenant Commander, viz.: *If single*, pay 32s. 6d.; servant allowance, 1s., plus medical staff allowance, 5s., equal to 38s. 6d. a day, or £702 2s. 6d. per annum. *If married*, as for single men, plus quarters and fuel and light allowance, totalling 3s. 6d. a day for wife and family (if not provided in kind) equal to 42s. a day, or £766 10s. per annum.

Ration allowance of 2s. a day is paid in addition in each case.

Conditions.—Engagement to be for 2 years from the date of arrival in, to the date of departure from, South Africa; with the option on the part of the Government to extend for a further period of one year.

Pay of 32s. 6d. a day only to be paid during the voyage to South Africa. Allowances to commence from the date of arrival at Simonstown.

Duty to be assumed on or about April 1, 1922.

Travel Concessions.—Free 1st class steamer passage to and from South Africa at beginning and termination of contract. Similar concessions in respect of wife and not more than four children under 18 years in the case of girls and 16 years in the case of boys.

Applications, together with copies of testimonials, all in duplicate, should be lodged not later than January 16, 1922, with the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C. 2, from whom forms of application may be obtained.

TERRITORY OF NEW GUINEA.

VACANCY FOR DIRECTOR OF AGRICULTURE.

Applications are invited for appointment as DIRECTOR of AGRICULTURE in the Territory of New Guinea, administered by the Commonwealth of Australia under mandate from the League of Nations.

The duties of the Director of Agriculture will be to advise on the agricultural development of New Guinea (both as to European-managed plantations and native gardens); to supervise scientific inquiries respecting plant diseases, soils, etc.; and to control and manage under the Administrator the Agricultural Department of the Territory.

Applicants must have had a thorough training in the sciences underlying agriculture (honours degree preferred) and some experience of tropical agriculture (coconuts preferred). Age under 40 desirable.

The appointment will be in the first instance for 5 years, with opportunity of renewal if services are satisfactory.

The salary will be not less than £1000 per annum. Applicants should state the salary they require. There is no provision at present for pensions, but the successful candidate will enjoy any pension benefits applicable to the post which may hereafter be conferred.

First-class passage to Rabaul via Australia for appointee and family (not exceeding three adult fares) will be provided, and return passages if the appointee completes five years' service. Three months' furlough will be allowed after two years' service.

Applications should be addressed to the OFFICIAL SECRETARY FOR AUSTRALIA, Australia House, Strand, London, W.C. 2, and should reach him not later than March 31, 1922.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.

SOUTH KENSINGTON, S.W.7.

DEPARTMENT OF CHEMICAL TECHNOLOGY.

WANTED, a temporary RESEARCH-DEMONSTRATOR, for one year as from January 1, 1922, to supervise research work; must have a sound knowledge of electro-chemistry and gas-analysis.

For particulars apply to the SECRETARY.

SOUTH-WESTERN POLYTECHNIC INSTITUTE,

CHELSEA, S.W. 3.

Day and Evening Courses in Science under Recognised Teachers of London University.

I. INDUSTRIAL CHEMISTRY DEPARTMENT.

Technical Courses in Analytical and Manufacturing Chemistry, Pharmacy, Food and Drugs, A.I.C. Courses, Metallurgy, Assaying, Foundry Work, Research.

II. INDUSTRIAL PHYSICS DEPARTMENT.

Practical work in General Physics, Applications to Industries, Metrology, Calorimetry, Illumination, Acoustics, Electrical Measurement, Research.

III. BIOLOGICAL AND GEOLOGICAL DEPARTMENT.

Courses for B.Sc., etc., in Botany, Geology, Mineralogy, Zoology. Special Courses in Bio-chemistry, Bio-physics, Bacteriology, Physiology, Hygiene, Entomology, Plant Pathology. Course for Tropical Planters, Research.

Lent Term begins on January 9, 1922.

Telephone: Kensington 899.

SIDNEY SKINNER, M.A., Principal.

UNIVERSITY COLLEGE, JOHANNESBURG.

DEPARTMENT OF CHEMISTRY.

Applications are hereby invited for the vacant post of LECTURER in CHEMISTRY at the above-mentioned College, which is shortly to be incorporated as a University.

Salary: £464 per annum on scale £464–£26–£568.

Qualifications: Special qualifications in Physical Chemistry will be a recommendation. Candidates should state their age.

Travelling Concessions: Half salary during voyage and £40 grant towards expenses of journey to South Africa.

The successful candidate will be required to commence duty as soon as possible.

Applications, with copies of testimonials as to qualifications, experience, and character (all in triplicate), should be lodged not later than December 31, 1921, with the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C. 2, from whom further particulars may be obtained.

SALFORD EDUCATION COMMITTEE.

ROYAL TECHNICAL COLLEGE.

Principal—B. PRENTICE, D.Sc., Ph.D.

Applications are invited for the following appointments:

(*a*) ASSISTANT LECTURER in CHEMISTRY. Experience of Physical Chemistry and Applied Chemistry (Cotton Dyeing) desirable. Good Honours Degree.

(*b*) LECTURER in PHYSICS. Graduate of a British University.

Burnham salary scale both posts. Particulars and forms of application from the undersigned.

R. MARTIN, Secretary.

Education Office,
Salford.

UNIVERSITY OF BIRMINGHAM.

FACULTY OF MEDICINE.

PROFESSORSHIP OF ANATOMY.

The Council of the University invites applications for the CHAIR OF ANATOMY, vacant by the death of Professor Peter Thompson.

The stipend offered is £1000 a year.

Applications (12 copies) may be accompanied by testimonials, references, or other credentials, and should be received by the undersigned on or before February 28, 1922.

Further particulars may be obtained from

GEO. H. MORLEY, Secretary.

ACCURATE CHEMICAL THERMOMETERS.—110° C., 150° C., 250° F., 300° F., 2s. each; 200° C., 2s. 3d. each; 360° C., 400° F., 3s. each; 550° C., special glass, 10s. each. Also singles and sets in all graduations to 1/10°.—CHEELD, Chesham.

THE PROPRIETOR OF BRITISH PATENT No. 111570, dated December 22, 1916, relating to "AN X-RAY APPARATUS," is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above Patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois.

HONOURS BOTANIST requires post while studying post-graduate Agricultural Chemistry or Mycology. Willing to go abroad.—BOX 22210, NATURE Office.

THURSDAY, DECEMBER 22, 1921.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

Carbon Monoxide in Public Gas Supplies

MORE than ordinary interest is attached to the Report before us,[1] inasmuch as it deals with issues of considerable importance from the points of view both of national economy and of public health. To understand the question involves not only some knowledge of the history and conditions of public gas supplies during the past century, but also a right perspective in our views as to the most economical solution of the domestic smoke problem.

For nearly eighty years after the establishment of the first public gas-works in London in the year 1813, the gas undertakings in Great Britain supplied their customers with what has been called a "straight coal-gas," or, in other words, with a gas obtained by the carbonisation of a bituminous coal (sometimes mixed with a small proportion of "cannel-coal") in retorts. In the early days of the industry, cast-iron retorts were employed, necessitating the use of comparatively low temperatures (650–750° C.) and the production of a rich lighting gas and a "soft" coke, which latter could be utilised effectively in domestic fire-places. It is significant that the name of the first London gas undertaking was the Gas Light and Coke Company, and that Frederick Accum, who in 1819 wrote the first descriptive treatise on the manufacture of coal-gas, was able to say that "the demand for coke in the capital, since the establishment of the gas-light works, has prodigiously increased. Numerous taverns, offices, and public establishments which heretofore burnt coal, now use coke to the total exclusion of coal; and in every manufactory which requires extensive lighting or heating, gas and coke are now the means jointly employed." It would thus appear that, a century ago, the London gas undertakings, by their enforced practice of carbonising coal at moderately low temperatures, supplied the public with two "smokeless" coal products, namely, gas for lighting and a soft coke for heating purposes, the *combined* use of which made possible the abandonment of the burning of raw coal in houses, offices, and public establishments.

As time went on, however, cast-iron retorts were replaced by those of fireclay in the gas-works, with the natural result that higher carbonising temperatures were employed. But even fifty years ago, when this change had become universal, the chief object of the gas undertakings still remained the production of a coal-gas of high self-illuminating power together with a coke of such "medium" porosity and texture that it would answer most domestic fuel requirements. The coal-gas of fifty years ago would probably contain (about) 0·25 per cent. of CO_2, 6·0 of CO, 5·0 of "heavy hydrocarbons," 40·0 of methane, 45·0 of hydrogen, and 3·75 of nitrogen, and its gross calorific value would be (about) 700 B.Th.U. per cb.ft., measured *dry*, at 60° F. and 30 in. barometric pressure.

With the rapid development, from 1890 onwards, of incandescent mantle gas lighting, which followed close upon A. von Welsbach's inventions in Germany (1885–95), and the concurrent increasing use of gas for cooking and domestic heating purposes, which were the outcome of Thomas Fletcher's pioneering efforts in this country, the need of a rich gas of high self-illuminating power diminished, and eventually almost disappeared. The demand arose for a cheaper gas of medium illuminating (say of 15–17 candle-power) but good heating power (say of about 600 B.Th.U. gross per cb.ft. at 60° F. and 30 in. barometric pressure). This led to raising the carbonising temperature in the retorts up to 1000° C. or more, and using "regenerative" methods of firing the retort settings, whereby some 12,000 cb.ft. of gas per ton of coal were produced, containing about 2·5 per cent. of CO_2, 6·0 of CO, 3·5 of heavy hydrocarbons, 33·0 of CH_4, 5·0 of H_2, and 5·0 of N_2, and having a *gross* calorific value up to about 600 B.Th.U. per cb.ft. at 60° F. and

[1] Gas Regulation Act, 1920. Report to the Board of Trade of the Departmental Committee on Carbon Monoxide. Pp. 12. (Cmd. 1422.) (London: H.M. Stationery Office, 1921.) 1*d.* net.

30 in. barometric pressure. As the carbonising temperature increased, however, the residual coke became gradually harder, and therefore less suitable for domestic consumption, especially in an open fire-place with low draught. Indeed the gas undertakings soon found themselves in the position of producing a coke which was neither a good domestic fuel nor yet a high-class, hard metallurgical coke, with the result that its profitable disposal was often a matter of difficulty.

An obvious way out was to convert part of the coke into "water-gas," by one or other of the processes which had been developed since the first Lowe plant had been installed in Great Britain at the Leeds Forge in the year 1888. And by mixing some water-gas with the coal-gas, a larger proportion of the potential heat-units in the coal taken into the gas-works could be sent out in the form of gas. Moreover, water-gas is cheaper to produce, and has an even higher calorific intensity (flame temperature), although the thermal efficiency of its production is somewhat lower, than that of coal-gas. Another important advantage about water-gas is that the plant for producing it occupies a much smaller area than a coal-carbonising plant for equal gas-therm yields; and, moreover, its operation is so comparatively easy and labour-saving that, to the harassed gas engineer, it is "a very present help in time of trouble," *e.g.* when coal supplies are unduly short or the demands of labour excessive. Up to the outbreak of the war, however, British gas undertakings had been commendably chary in using water-gas; indeed, it is probable that in the year 1913 the proportion of water-gas sent out did not, on the average, exceed (if it was as much as) 15 per cent. of the whole gas output of the works. The public would, in that year, be supplied with a gas of an average gross calorific value of about 575 B.Th.U. per cb.ft. at 60° F. and 30 in. pressure, of which the content of carbon monoxide did not exceed 15 per cent. at the most, and more probably in the majority of cases would not be greater than 10 per cent.

It may here be mentioned that in the United States, where the manufacture of water-gas originated in 1885, the policy of converting the coke into water-gas and of carburetting the latter with oil-gas had, long before the war, been pushed almost to its extreme limits. Thus New York had long been supplied with a mixture of about one part of "coal-gas" with as much as six or seven parts of "carburetted water-gas"; Chicago with a mixture of one to five parts; Boston with a mixture of equal volumes, and so on. In 1917, the New York gas contained, on an average, about 3·0 per cent. of CO_2, 27·0 of CO, 12·5 of heavy hydrocarbons, 20·0 of methane, 30·0 of hydrogen, and 7·5 of nitrogen; and its average calorific value would probably be about 675 B.Th.U. per cb.ft. at 60° F. and 30 in. barometric pressure.

During the war circumstances arose which fully justified, as a temporary measure, the relaxation of some of the conditions formerly imposed upon British gas undertakings, which were permitted to supply gas of much lower calorific value and higher water-gas content than in pre-war days. In the circumstances this could not well be helped, and it was endured by consumers without complaint as a war necessity. Unfortunately, however, the gas industry, having thus been liberated temporarily from former controls and restrictions, yearned for a more permanent emancipation therefrom; and so what may be termed a strong "life and liberty" movement set in, more particularly in the direction of supplying gas of lower calorific value, on the plea of benefiting the consumer by giving him cheaper gas-therms than otherwise he could obtain.

At this point the Fuel Research Board stepped in, at the request of the Board of Trade, with the object of advising "what is the most suitable composition and quality of gas and the minimum pressure at which it should be generally supplied, having regard to the desirability of economy in the use of coal, the adequate recovery of by-products, and the purposes for which gas is now used." The answer of the Fuel Research Board to the prevailing view in the gas industry "that the elasticity in manufacture can best be secured by the fixing of a sufficiently low calorific standard" was somewhat vague and hesitating; but the Board rightly based its recommendations upon the principle that "the interests of the consumers can best be conserved if their contract with the gas undertaking is based on the sale and purchase of heat energy measured in fixed units which can be scientifically determined by simple means." And it was therefore proposed that "the consumer should be charged for the thermal units which he actually receives in the same way as the consumer of electricity is charged for the Board of Trade units which pass through his meter." This important conclusion was, however, accompanied by a pronouncement that "the natural diluent for coal-

gas is water-gas"; and the Board finally recommended that, subject to the foregoing principle, the gas undertakings should be "free to deliver to the consumer any mixture of the ordinary combustible gases free from sulphuretted hydrogen and not containing more than 12 per cent. of inert constituents," whilst suggesting "the standardisation of burners in appliances for a limited number of calorific values" between 400 and 500 B.Th.U. per cb.ft. The Board's main recommendations, except as regards inert constituents, were given effect to by the Gas Regulation Act of 1920, which also provided (*inter alia*) that the Board of Trade shall, as soon as may be after the passing of this Act, cause an inquiry to be held into the question whether it is necessary or desirable to prescribe any limitations of the proportion of carbon monoxide which may be supplied in gas used for domestic purposes.

Now, whilst it is generally admitted that there are certain economic advantages to be gained by supplying the public with coal-gas diluted with water-gas, there are, nevertheless, weighty objections to an *unlimited* proportion of the latter being allowed in a domestic gas supply, arising from the poisonous nature of carbon monoxide (of which water-gas contains about 42 per cent., as against, say, 7 per cent. in coal-gas), and also from the fact that the range of explosibility of water-gas–air mixtures is considerably wider than that of coal-gas–air mixtures. Any *large* admixture of water-gas with coal-gas in a domestic supply would add materially to the dangers both of carbon monoxide poisoning and of gas explosions in houses.

The dangers of carbon monoxide poisoning with gas containing a large proportion of water-gas formed the subject of an official inquiry by a Committee (of which Dr. J. S. Haldane and the late Sir William Ramsay were members) appointed by the Home Office, whose Report (Cmd. 9164) was issued in the year 1899. This Committee considered that the most probable manner in which accidental death from gas poisoning would occur would be from gas, inhaled during sleep, escaping from a burner left full on unlighted; and, influenced by experiments made by Dr. Haldane, as well as by detailed information laid before them as to the uses of water-gas in the United States and its effect upon human health, and having in mind also the nature of carbonic oxide poisoning and the faulty character of gas pipes and fittings in the poorer class of house, the Committee reported that "the most direct, and in our opinion, the only effective method of preventing danger from water-gas is to fix a limit which the carbonic oxide in a public and domestic gas supply shall not, in ordinary circumstances, exceed." And, whilst admitting the difficulty of assigning a limit applicable in all circumstances, they suggested that 12 per cent. of carbonic oxide would in ordinary circumstances be a proper limit, with 20 per cent. as the highest that should ever be allowed, and that "only under special circumstances." Since this Committee reported there has probably been some (though not a great) improvement in the character of the gas service-pipes and fittings in the poorer class of houses. Also the more extended use of incandescent mantle lighting has undoubtedly meant that less gas (in the ratio of, say, 7 to 10) would nowadays escape into a bedroom, from a burner left full on unlighted, than twenty years ago. Therefore, if in 1899 somewhere between 12 and 16 per cent. of carbonic oxide was considered to be, "in ordinary circumstances," a proper limit, it would follow (the poisonous nature of carbonic oxide remaining unchanged) that to-day 20 per cent. might similarly be considered a reasonable maximum limit. This last-mentioned view was taken by the British Association Fuel Economy Committee in its Second and Third Reports (1919 and 1920), and afterwards supported, on physiological grounds, by Dr. J. S. Haldane in his evidence before the Board of Trade Committee. The adoption of such a limit would mean that the gas undertakings would be at liberty to supply a mixture of one hundred parts of straight coal-gas with (up to) fifty parts of blue water-gas, a fairly generous allowance of the last-named.

But the gas industry is to-day much more strongly organised and entrenched than it was twenty years ago. So, whilst admitting that few undertakings would be inconvenienced by a limit of 20 per cent. of carbonic oxide, except in cases of emergency, and disclaiming any present intention of supplying very high percentages of water-gas (in London a proportion of only $33\frac{1}{3}$ per cent. of carburetted water-gas being contemplated), its advocates argued before the Board of Trade Committee that the advantages of cheaper gas (although nowadays gas, at twelve to fifteen pence per therm, seems a very dear fuel) outweigh the danger to human life feared from higher proportions of carbon monoxide, and, therefore, that no statutory limitation should be imposed. Eventually, as the result of its inquiry, the Committee did so decide, being "greatly impressed by

the necessity of allowing the development of the gas industry to proceed, without any check on its natural progress."

Such was the Committee's conclusion on the matter, but it was qualified by the suggestion "that the Departments concerned should carefully watch the situation so that, if the freedom from limitation which we recommend is accompanied by unexpectedly unfavourable results, the attention of Parliament may, if necessary, be again directed to the matter," as though the Committee had still some misgivings about its verdict and did not consider it as final. Certainly, in the light of statistics relating to accidental gas poisoning placed before the Committee by the Registrar-General's Department, and those published for the years 1914–19 by the Gas and Electric Light Commissioner of Massachusetts, which are referred to in the Report, there would appear to be a much greater risk of accidental death from carbon monoxide poisoning in localities where coal-gas largely diluted with water-gas is supplied than in those in which no water-gas is added. Indeed, it seems arguable that, had the matter been decided mainly by such statistics, and on the physiological evidence, rather than on those of the cheaper production of gas, a verdict in favour of limitation would have been the more natural and appropriate one.

There is admittedly much to be said on hygienic grounds in support of the argument for cheaper gas, especially in view of the great improvements made during recent years in gas fires, and their consequent wider adoption for the heating of living rooms which are in use for part of the day only. For such purposes, as well as for cooking, gas is still an economical fuel, not so much on grounds of its initial cheapness (for it is a relatively dear fuel as compared with coal), as on those of convenience and cleanliness. It may, however, be argued perhaps with even greater force that, for the ordinary living rooms of a house, which require to be heated all day long, there is probably nothing more healthy and economical than radiation from red hot semi-carbonised coke burning in an open fireplace, and that it is in such direction, rather than that of gas heating, that the ultimate solution of the domestic smoke nuisance mainly lies, although undoubtedly each method will contribute to the desired end.

The Committee does not appear to have considered at all the question of the greater risks of back-firing and explosions arising out of the much wider range of explosibility of coal-gas when largely diluted with water-gas for a domestic supply, although this is a matter of some importance. Moreover, it seems to have been overlooked that whereas the gas supply of many American cities may contain as much as 25 to 30 per cent. of carbon monoxide, yet it would be of a much higher calorific standard (*vide* that of New York) than any gas supplied, or likely to be supplied, under the new regulation by British undertakings. Indeed, it is a matter of mere arithmetic that an American burner supplied with gas of 675 B.Th.U. per cb. ft., and containing 27 per cent. of carbon monoxide, would, for a given heat development in the flame, actually pass somewhat less carbon monoxide in a given time than a British burner supplied with a 475 B.Th.U. gas containing only 20 per cent. of carbon monoxide. It may, however, be hoped that British gas undertakings will, in their own interests, voluntarily work within such a 20 per cent. limit, and that gas consumers generally will fully realise the importance of keeping a sharp look-out for gas leakages and of using only the best-made taps and fittings.

W. A. B.

Diseases of the Rubber Tree (Hevea braziliensis).

The Diseases and Pests of the Rubber Tree. By T. Petch. Pp. x+278+6 plates. (London: Macmillan and Co., Ltd., 1921.) 20*s.* net.

THE growth of the rubber plantation business, in which many millions sterling of British capital are invested, provides a striking example of the advantages that accrue from the combination of science and industry. It is, indeed, not too much to say that but for this combination the rubber planting industry, as it has flourished during the last ten years or more, could scarcely have maintained its existence.

It is not necessary to direct attention to the essential aid which science has given in enabling the raw rubber to be fitted for its various commercial applications. On the other hand, the present extensive development of rubber in industry would not have been possible had not scientific help been at hand to enable the plantations themselves to be maintained. In the earlier days, as in many another tropical agricultural industry, all went very well with the planter—and then came the inevitable onset of disease, which under tropical conditions of growth may, and if unchecked will, easily assume serious proportions. The first serious check in the history of the plantation enterprise came in the form of a root

disease, due to the effects of a species of Fomes (*F. lignosus*). The life history of the disease was worked out, its source and the conditions of attack became known through scientific investigation, and then rational methods of control were devised.

Some optimists thought that thenceforth all serious trouble was at an end, but experience has confirmed the views of those who at that time expressed a contrary opinion. There are now known to be a number of pests, mostly fungal, which threaten more or less dangerously the existence of the rubber trees. It is not unlikely that others will appear in the future, which either have not yet gained access to the plantations or perhaps have not yet acquired their full virulence. At any rate it may be stated confidently that the maintenance of scientific investigation, which alone can provide the essential conditions for the control of disease, is a prudent measure that is of vital importance to the existence of the whole industry.

It is fortunate that the men who control largely the development of the great rubber plantations appreciate fully the services which science can render, and actually has rendered in the past, and this circumstance is one of the best guarantees of the future success of the enterprise.

Naturally, a considerable mass of knowledge has accumulated on the causes and methods of treatment of the various diseases to which the rubber trees are known to be liable, and it is fortunate that Dr. Petch, with his long experience in Ceylon, should have set himself the task of presenting, in a readily available form, the results of that experience in the book under notice. By the term "tree" is meant, of course, the Para rubber tree, *Hevea braziliensis*, which from the planter's point of view is the only rubber-producing plant of importance. Dr. Petch discusses the subject partly from the general point of view, and shows how neglect of correct principles of cultivation may promote disaster. He then describes the characters presented by the various parasites, and their several effects on the rubber tree itself, indicating, or at least discussing, the remedial or preventive measures which should be adopted. Excellent plates are given in the body of the work illustrative of the various diseases, and we could have wished it had been possible to print an explanatory legend at the foot of each plate, to avoid having to turn elsewhere in the text for identification of the figures; perhaps this may be possible in a future edition.

The book is much more than a mere guide to the pests, animal and vegetable, that afflict Hevea. Its pages abound in acute observations and suggestions that make it valuable from the point of view of general pathology, and render it of interest to a wider circle of readers than the rubber planters for whom it was primarily written. The author also hints at the preparation of a companion volume that shall deal with the subject from a more physiological point of view. The need for such a work is pressing, for quite apart from the more general aspects of pathology which may be expected to fall within the scope of such a volume, the whole question of the function of the complex latex and the problems of predisposition to disease have never yet received adequate treatment. For the present we conclude by congratulating the author on the production of a real contribution to the literature of economic botany, and the publishers also deserve commendation for the excellent form in which the subject-matter and the illustrations are presented to the reader. J. B. F.

Some Psychological "As Ifs."

(1) *Psychology and Mystical Experience.* By Prof. John Howley. Pp. xi+275. (London: Kegan Paul, Trench, Trubner and Co., Ltd.; St. Louis, Mo.: B. Herder Book Company, 1920.) 10*s.* 6*d.* net.

(2) *The Science of Ourselves.* (*A Sequel to the "Descent of Man."*) By Sir Bampfylde Fuller. (Oxford Medical Publications.) Pp. ix+326+2 plates. (London: Henry Frowde; Hodder and Stoughton, 1921.) 16*s.* net.

(3) *Religion and the New Psychology.* By W. S. Swisher. Pp. xv+261. (London: George Routledge and Sons, Ltd., n.d.) 10*s.* 6*d.* net.

(4) *Collected Papers on the Psychology of Phantasy.* By Dr. Constance E. Long. Pp. xii+216. (London: Baillière, Tindall, and Cox, 1920.) 10*s.* 6*d.* net.

(1) PROF. HOWLEY'S study is a sound piece of work written by one who has knowledge and training along lines of thought which we cannot afford lightly to dismiss. Without denying the validity of the concept of sub-consciousness (in some sense of the word) he rejects that of merely automatic combination of psychic elements therein. "We must," he says, "posit some agency other than the psychic elements considered in themselves." Mystic experience is a direct realisation, *sine intermedio*, by the agent of the Agent beyond. What the author speaks of as "agnostic psychology" may try to interpret this in terms of illusion; but how comes it that the illusion conduces to useful and sustained effort?

(2) Sir Bampfylde Fuller builds a super-

structure of thought-process, interpreted with some originality in the light of long experience in affairs, on a frankly materialistic foundation. Mind *is* (and not only is in some way correlated with) physiological process in the brain. The development of the cerebral hemispheres "introduces a new and peculiar nervous condition—that of consciousness." "Ideas are material things, and may be figured as clusters of brain-cells."

(3) Mr. Swisher gives us his solution of "*the* religious problem"—*i.e.* "the perfect adjustment of the ego to its environment—the immediate environment and the cosmos." To him the gospel of Freud carries glad conviction. When we grasp adequately the nature of the unconscious through the methods of psycho-analysis we shall realise its influence on the religious life. The conclusions to which the author has been led are set forth with much vigour and freshness, and if he is satisfied "that religion had a phallic origin" he has full right to say so. The chapter on mysticism and neurotic states invites comparison with Prof. Howley's more "academic" treatment based on convictions derived from an older gospel.

(4) Dr. Constance E. Long founds her doctrine rather on the fourth gospel of Jung than on the second gospel of Freud, though both must be included in the canonical books of the new faith. A candid friend, who is an academic psychologist, bade her—as she tells us in the preface—alter her title, saying that the book has nothing to do with psychology. She retained it, however, "because the book deals with an aspect of phantasy to which academic psychology is paying considerable attention at present." At the same time she warns her readers that they will find in it nothing about such matters as "the relation of imagination to perception." One would have thought that the discussion throughout turns very largely on the nature of this relation. At all events, whatever label others may see fit to affix to him, no psychologist can afford to disregard new facts in whatever manner they may be reached, and Dr. Constance Long adduces many facts which are worthy of careful consideration.

Huxley was wont to warn us against passing too lightly from "as if" to "is," pointing the moral in one of his class lectures by reference to Darwin's twenty years' testing of natural selection. He did not disparage the value of hypothesis; his meaning was that we should differentiate the several values of our hypothetical "as ifs," and lay bare the evidence which marks the difference in probability between the 0·95 which approaches the, perhaps unattainable, 1 of "is," and the 0·05 which is all that sundry flimsy conjectures can legitimately claim. It looks as if the integration which obtains in human fantasy and thought were due to an integrating agency other than the natural relatedness of the psychic elements considered in themselves. It is for Prof. Howley to assign the probability-value of this "as if" and to marshal the evidence in its favour. To Sir Bampfylde Fuller it looks as if thought were *in pari materia* with cerebral organisation; it is for him to state the probability-coefficient of this hypothesis and produce evidence in support of its approximation to 1. It looks as if there were imaginal complexes in that which seems as if it were a psyche nowise dependent for its existence on the structure and function of the brain; it is for Dr. Constance Long and Mr. Swisher to justify their existential "is" in the unconscious.

An "as if" accepted as "is" becomes a basal assumption or presupposition from which flows the "must be" so obvious to the acceptor that demand for evidence on the part of the critic seems unreasonable. Memory-images as such "must be" retained somewhere; if not in consciousness, and if not in the brain, then obviously in the unconscious. Retention otherwise than as such—*i.e.* retention of the conditions under which fresh blossoms of imagery shall appear under appropriate excitation—is left out of consideration; but should it not be considered and the ground of rejection laid bare? Retention of memory-images as such in the unconscious seems to be the cardinal "as if" of much psycho-analysis; but is it wholly unreasonable to ask for evidence?

To put the matter more concretely, suppose that someone has a dream in which there are certain imaginal factors in fantasy—say, *k*, *m*, *o*. On a later occasion, by the method of "free association," other factors—say, *j*, *l*, *n*, *p*—are *then* rendered supra-liminal. What is the probability-value of the inference that they were subliminally present *as imaginal factors latent on the prior occasion of the dream?* There is here no question of familiarity with the facts. We may grant that as facts they are given correctly. It is a matter of evidence for or against an "as if" on the basis of which the facts are interpreted.

C. LL. M.

Our Bookshelf.

Penrose's Annual. Vol. 24 of *The Process Year Book and Review of the Graphic Arts*, 1922. Edited by W. Gamble. Pp. xii + 91 + plates. (London: Lund, Humphries, and Co., Ltd., 1921.) 8*s.* net.

ALTHOUGH the editor has nothing particularly new to bring forward this year, he has succeeded in

making a very interesting and instructive volume. We think that the illustrations, which are many and various, reach a rather higher standard of excellence than that to which we have been accustomed. The editor tells us that undoubtedly, in time, all text-composing for printing will be done by a photo-mechanical process, and that this matter is still being worked at and progress made. Collotype, which many used to suppose to be too troublesome to work in this country, because of the vagaries of the climate, appears to be gaining in favour, and can be combined with offset methods to considerable advantage. An example of such a combination is given in a coloured collotype of Messrs. Howard and Jones. The history of the Print Society by Mr. M. F. Whittington, with offset examples, will be appreciated by many artists and collectors who favour etching as a means of expression. Mr. Gamble, in his "Review," refers to the neglect of inventors and inventions, and we would heartily second his desire that such neglect might be avoided. He is, however, unfortunate in one of his examples —namely, the "Electrical Inkless Printing" process, which was shown some five-and-twenty years ago by the late Mr. Friese Greene. Mr. Gamble says that Mr. Greene "was unable to find the necessary financial support, and the process died out of recollection." The weak point of that method was diagnosed in a moment by those who were well grounded in scientific principles. The paper was sensitised all over (essentially by a salt of manganese), but the sensitive material unused was not, and probably could not be economically, removed. The present writer has specimens that were then produced. For years they have been covered with a dirty brown stain, often in smudges, and the staining has extended to the envelope that contains them.

C. J.

Vorlesungen über die Theorie der Wärmestrahlung. By Prof. Max Planck. *Vierte, Abermals Umgearbeitete Auflage.* Pp. xi+224. (Leipzig: Johann Ambrosius Barth, 1921.) 36 marks.

THIS work has now gone through four editions, and it remains the standard book on the theory of radiation. The earlier parts, dealing with the classical theory, are practically unaltered, and constitute still far the most thorough introduction which a student could have into the rather difficult ideas of the theory. The later part differs from the earlier editions very considerably. In the first and second editions the end of the book contained a good deal of rather arid discussion of the radiation problem from several only slightly different points of view. All this has now been replaced by a very interesting development of the quantum theory, in particular of those branches, including radiation, which concern temperature problems. The discussion from the point of view of entropy is very complete, except for the lack of an explanation of why it is right first to define entropy in terms of probability, and then to re-define probability—the so-called thermodynamic probability—so as to derive from it the "absolute" entropy. Apart from this question of the arbitrary constant in the entropy, there is a very clear account of Planck's more recent work on the equation of state of gases.

Der Entropologische Gottesbeweis: Die physikalische Entwicklung des Entropieprinzips, seine philosophische und apologetische Bedeutung. By Dr. Josef Schnippenkötter. Pp. 109. (Bonn: A. Marcus and E. Webers Verlag, 1920.) 15 marks.

To anyone familiar with modern physics it is a frequent occurrence to observe encroachments of the second law of thermodynamics on more and yet more branches of science; but it comes at first as rather a surprise that it covers a still wider field and has also an application in theology. Yet the connection is not so remote as appears at first sight, for alone of all the laws of Nature the second law deals with non-conservative processes. According to a certain school of thought the laws of dynamics and electro-dynamics, being conservative, might be left to run themselves, but the degeneration of energy can only be taken to prove that the world must have been started at some time and must end at some future date—hence the title. The author of this philosophical work has evidently read widely in the literature of the philosophy of science and in science itself. There are discussions of 320 papers in it; indeed, almost every page is covered with references. He draws the cautious conclusion that entropy does not necessarily imply the existence of the Deity.

A Text-book of Qualitative Analysis of Inorganic Substances. By Dr. S. A. Kay. Pp. vii+80. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1921.) 7*s.* 6*d.* net.

THE practical details of analysis are described in this book more minutely than is customary in order to minimise the necessity of constant supervision of the student. All accounts of the theory, even the chemical equations of the reactions, are omitted. These are to be discussed orally. It would, however, have been very much better to have included them, since students usually carry out the tests mechanically unless they have their attention constantly directed to the chemistry involved. The result is rather reminiscent of cookery.

Geography for Junior Classes. By E. Marsden and T. A. Smith. Pp. viii+278. (London: Macmillan and Co., Ltd., 1920.) 5*s.*

THE book under notice is suggestive of the bad old geography furbished and brought up to date. The last three parts cover the British Empire, and a general view of the continents. The first is mainly pure physics of a brand which is not welcome. The phrase "Lines and Belts of Equal Heat" is bad anywhere, but much worse in a head-line. The book will not help to improve school geography.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Tendency of Elongated Bodies to Set in the East and West Direction.

PERHAPS readers of NATURE will recognise the principle of the Eötvös torsion balance in the communication of Sir Arthur Schuster published in NATURE of October 20 (p. 240) entitled "The Tendency of Elongated Bodies to Set in the North and South Direction." The calculation there given is, however, incomplete, and this causes the sign of the effect to be reversed. For the hypothetical "normal case" a complete calculation shows that the tendency is rather for an elongated body to set itself in an east and west direction. The missing element in the calculation is the difference in the directions of the centrifugal force on the different portions of the rod. If we call λ the longitude, reckoned from the meridian of the centre of the rod, of an element ds of the rod at distance s from the centre, then approximately $\lambda = s \sin\phi / a \sin\theta$, where a is the radius of the earth and the remaining notation is the same as in the original communication. Since λ is small, we may write for the horizontal force perpendicular to the meridian of the centre of the rod $\sigma\rho\omega^2\lambda ds$; its moment is $(\sigma\rho\omega^2\lambda ds)(s\cos\phi)$, or, finally, since $\rho = a\sin\theta$, the moment of an element of length ds is

$$\sigma\omega^2 s^3 \sin\phi\cos\phi\, ds.$$

It is easily seen that the horizontal component of the centrifugal force is always directed outward from the central meridian, and therefore tends to bring the rod into the prime vertical. The above expression combines with the moment given in the original communication, namely, $\sigma\omega^2 s^2 \cos^2\theta \sin\phi\cos\phi\, ds$ (after correcting an obvious typographical error), giving

$$\sigma\omega^2 s^2 \sin^2\theta \sin\phi\cos\phi\, ds.$$

By integration along the rod we get for the entire turning moment

$$I\omega^2 \sin^2\theta \sin\phi\cos\phi,$$

where I denotes the moment of inertia, as in the original communication.

As a matter of fact, we must consider not only the effect of the change in direction and amount of the centrifugal force, but also the changes in gravity due to the departure of the earth from a spherical form. We have, in effect, treated the earth as a spheroid having an ellipticity due only to the direct effect of the centrifugal force—that is, an ellipticity of $\omega^2 a/2g$, where g is the acceleration of gravity. We may get the complete expression by writing instead of $\omega^2 a/2g$ the actual ellipticity of the earth, e. (This is not offered as a proof.) The result is

$$(2egI/a) \sin^2\theta \sin\phi\cos\phi.$$

In an article of mine published in the September issue of the *American Journal of Science*, and briefly noticed in NATURE for October 6 (p. 192), I have described the Eötvös balance from a different point of view, and have shown how the rod may be thought of as falling while turning about its axis of suspension, because, owing to the different curvatures of the different vertical planes, it actually diminishes its potential energy in turning. The prime vertical is the vertical plane of minimum curvature in the normal case, and it is towards this vertical plane that the body tends to turn.

Now experiments with the Eötvös balance have shown that the actual condition at any particular point is generally very far from normal, so much so that it is quite conceivable that at the place of Mr. Reeves's experiment the tendency should be more nearly towards the meridian than towards the prime vertical.

The body tends to set itself in the vertical plane of minimum curvature, wherever that may be, and if we reckon the angle from this plane the moment of the force acting is numerically

$$gI(1/R - 1/N) \sin\phi\cos\phi,$$

where R and N are the minimum and maximum radii of curvature of the level surfaces of the earth's gravity field at the point of observation. For the "normal case" this expression readily reduces to the one already given. Observations with the Eötvös balance enable us to determine for any point the value of $1/R - 1/N$ for the level surface passing through the centre of the rod and the directions of the principal planes of curvature of the level surface. There is also a second type of Eötvös balance in which a mass at one end of the rod is balanced by a weight suspended from the other by a fibre of some length.

To illustrate the erratic nature of the curvatures of the level surfaces near the surface of the earth when these are studied in detail, I take from the work of Prof. Soler ("Prima Campagna con la bilancia di Eötvös nei dintorni di Padova," Venice: Reale Commissione Geodetica Italiana, 1914) the following values of the angle β, which is the angle between the meridian and the direction in which gravity is increasing most rapidly. The normal value of β is zero. The actual values at a number of successive stations, all near Padua, were found to be 189°, 147°, 282°, 306°. 274°, 33°, and 304°. The balance used here was of the second type.

Although the curvature of any level surface near the earth is very irregular in detail, it is fairly regular on the average. That is, we may consider the level surface as made by superposing on a fairly smooth surface a number of undulations, short and sharp, but of small amplitude. The Eötvös balance picks up mainly the curvatures of the sharp undulations, while in ordinary geodetic work we get only a sort of average curvature of the surface on which the undulations are superposed.

WALTER D. LAMBERT.
U.S. Coast and Geodetic Survey,
Washington, D.C., November 21.

Japanese Culture Pearls.

A NOTICE has recently appeared in the daily Press, signed by a number of jewellers, with reference to Japanese "culture" pearls. This notice, besides endorsing the opinion expressed by the diamond, pearl, and precious stones section of the London Chamber of Commerce that "the insertion of foreign matter placed in the oyster" disqualifies the culture pearl from competing with the pearl produced without the aid of man, declares that "cultured" pearls can be distinguished from Indian pearls.

The first of the above statements was justly ridiculed at the time it was made by Sir Arthur Shipley in a letter to the *Times* (May 7, 1921), and is not likely to be taken seriously by the more intelligent members of the pearl-purchasing public.

The second statement is, however, sufficiently inexact to be liable to mislead the public. The only established difference between the culture pearls now on the market and "Indian" pearls, a difference revealed by their different fluorescence under ultra-violet light, is one that holds good also for "naturally produced" pearls from the Japanese pearl oyster, and is due to minute differences in the optical properties of the nacre of the Persian Gulf and Japanese oysters. An attempt is thus made to depreciate culture pearls by confusing them with naturally pro-

duced Japanese pearls, while the fact that culture pearls produced in other localities, or in other species or races of pearl oysters, will probably be indistinguishable from naturally produced pearls from the same sources is not mentioned.

It is a significant fact that the English pearl merchants and jewellers have apparently made no attempt to obtain and publish scientific opinions on the problems raised by the coming of the "culture pearl." This will probably prove in the end a shortsighted policy. It is quite likely that the values of the stocks of "natural" pearls which are held by merchants and others will suffer very much more from the uncertainty and confusion which are created by statements like those referred to here than they would have suffered from a full and frank explanation to the public of the exact nature, and probable future development, of the Japanese discovery. This discovery, important as it is as a scientific achievement, need not have produced the panic which, to judge from their behaviour, seems to prevail in certain sections of the precious stones trade. If at the outset the merchants and jewellers had acted as realists instead of behaving (and thinking they could induce the public to behave) in the manner so often wrongly attributed to the ostrich, it is quite likely that the pearl market would by this time have adjusted itself to the change. H. LYSTER JAMESON.

A Curious Physiological Phenomenon.

AT a recent meeting of biologists at Strasbourg Messrs. A. Schwartz and P. Meyer directed attention to the curious physiological phenomenon which is shown by the following experiment:—

With arms hanging relaxed, stand about 18 in. from any solid structure, such as a wall, and face the direction parallel to the wall. Stiffen the arm next the wall and move it away from the body until the back of the hand comes into contact with the wall; stand firm and press the wall as hard as possible with the back of the hand for about 15 seconds. Now relax the arm, step away from the wall, and this is what will happen:

To the observer's astonishment, his arm will slowly rise, without his making any voluntary effort, until it reaches an approximately horizontal position; it will remain there for a few seconds and then fall back. Whilst the phenomenon is taking place the observer has the sensation that his arm is raised by an exterior force which is quite independent of volition. Anyone interested in the explanatory theories put forward by the above-mentioned gentlemen should consult the *Comptes rendus de la Société de Biologie*, vol. 85, No. 27, July 23, 1921, p. 490.

F. C. DANNATT.

198 Rue Saint-Jacques, Paris (5e), November 28.

I FIRST came across this phenomenon in 1917, when it was shown as a "parlour trick" in an officers' mess in Macedonia. It is obviously of the greatest interest, but I was unable to trace it to its origin.

To the description in Mr. Dannatt's letter may be added the observation that the movement ensues even where the subject has no knowledge of what is about to occur—my first personal experience of the phenomenon occurred before I was told what to expect. This is of importance, for it removes possibility of "suggestion." The phenomenon is a physiological one.

Any explanation at present must be purely hypothetical. The "voluntary" movement of a limb is brought about through the activity of the "motor" area pyramidal cells in the cortex of the great brain. Such reactions (under experimental conditions) are often followed by the opposite form of movement—*e.g.* flexion by extension (Graham Brown and Sherrington, Proc. Roy. Soc., B, vol. 85, p. 250, 1912). But the peculiarity of the present movement is that it is in the same direction as the original one. That is, the upper limb is pressed against the wall in a voluntary manner; after a few seconds' rest it is raised towards the wall in an involuntary manner. After-discharge of the same movement may, however, also occur under experimental conditions (called "tonus remainder" by the above investigators). But this involuntary movement of the arm occurs after a distinct pause.

The curious lack of "volition" whilst the arm is rising might be explained (on the assumption that the movement is due to an after-discharge of the motor cortical area) if the feeling of voluntary fatigue depends upon functional changes a step back in the cerebral path. Thus the motor cells are set into activity by other nerve cells. If the fatigue of volition occurs in these other cells, and the after-discharge in the motor cells themselves, the absence of a feeling of "voluntary effort" might be explained.

The movement—the slow, involuntary rise of the arm—is, however, not like those obtained from the motor area of the great brain when it is stimulated. But it *is* like the movements obtained from another motor mechanism—that of the "red nucleus" and other structures in the mid-brain and hind brain. I think that the phenomenon is far more likely one brought about by this other motor system, which is essentially concerned in the slow "postural" movements and maintained postures of the body (Graham Brown, Proc. Roy. Soc., B, vol. 87, p. 145, 1913). It is more than likely that the two motor mechanisms combine in directing muscular activities—sometimes reinforcing one another, sometimes inhibiting. If this is the case, the pressing of the arm against the wall may be brought about by both mechanisms, the drop of the arm at the end of the voluntary act may be an additional voluntary act, and the after-discharge of the "red nuclear" mechanism (to give it a too restricted name) may later reassert itself. *Or* the "motor area" activity may from the first inhibit the "red nuclear," and when the former is "fatigued" the latter may assert itself in a "rebound" from its state of inhibition.

Enough has been said to indicate our ignorance of the conditions which might explain the phenomenon and to show how speculative any explanation must be at present. One last suggestion may be made. The phenomenon may be related to the curious maladjustment of movement which occurs after a heavy weight has been carried for a distance and then abandoned. Everyone who has carried a heavy knapsack for a distance and then laid it down knows how his first few steps without it are unbalanced.

T. GRAHAM BROWN.

Physiology Institute, University College, Cardiff, December 8.

Echinoderm Larvæ and their Bearing on Classification.

IN NATURE of December 8 there appears an article by my friend Dr. F. A. Bather entitled "Echinoderm Larvæ and their Bearing on Classification." The article consists of a review of Dr. Mortensen's work entitled "Studies of the Development and Larval Forms of Echinoderms," and in the course of the article Dr. Bather quotes with apparent approval some remarks of Dr. Mortensen to which I desire to take the strongest exception.

First, Dr. Bather quotes an observation of Dr. Mortensen's in which he describes the larva of an Ophiurid dropping the young brittle-star and then proceeding to regenerate itself, and states that this observation suggests that the metamorphosis of Echinoderms is an alternation of generations. I can only say that this observation of Dr. Mortensen stands in urgent need of confirmation, and that it is totally opposed to what we know of the normal development of Ophiurids. In the development of *Ophiothrix fragilis* the adult takes over from the larva the mouth, œsophagus, stomach, intestine, peritoneal sacs, and aboral integument, and what is left of the larva after this abstraction is merely the ciliated band, the larval organ of locomotion. This development is no more an alternation of generations than is the development of the veliger into the adult mollusc. The same type of metamorphosis is found in the pelagic larvæ of Holothuroids and Echinoids; in Asteroids the only additional feature to be observed is the shrivelling and disappearance of the præoral lobe which acts as stalk during the earlier stages of metamorphosis. Secondly, Dr. Bather states that Dr. Mortensen has shown that the Brachiolaria stage in Asteroid development (in which the larva uses its præoral lobe as a stalk) cannot be homologous with the similar stage of development in Crinoids, since it is found only amongst the "more specialised forms of Asteroids."

No more rash statement could be made nor one more devoid of foundation. Modern Asteroids are divided into five groups, viz. Forcipulata, Valvata, Velata, Paxillosa, and Spinulosa. Nothing whatever is known of the development of any valvate and velate form, but the fixed stage is found not only in the development of the Forcipulata (which Dr. Mortensen arbitrarily regards as the most specialised forms), but also in the development of the Spinulosa (which all admit to be the most primitive group). In the Paxillosa, which include the British genera Astropecten and Luidia, and which, *mirabile dictu*, Dr. Mortensen appears to regard as primitive forms, the fixed stage is omitted; the larva apparently amputates its præoral lobe and does not use it as a stalk.

The Paxillosa, so far from being primitive, are quite a modern development of Asteroid structure in the Ophiuroid direction. They have in most cases lost the anus and in all cases the sucking discs of the tube feet, and they have developed a quite un-Asteroid mobility and muscularity of the arms. Luidia even snaps off the arms on irritation exactly like an Ophiuroid.

The reason why the fixed stage is omitted in their development is not far to seek. What we know of their habits points to their being inhabitants of the sand and mud. Such a habitat is utterly unsuitable for the support of a fixed stage, and consequently this stage has been omitted in their life-history.

When, however, we reflect that the Echinoderms are admitted by all to be descended from the same stock, that this stock must have passed through a fixed stage, since primitive Crinoids are fixed, and that the stalks of Crinoids and Asteroids are formed from the same region of the larva, we shall be in a position to estimate the value of Dr. Mortensen's views. His ideas of the ancestry of Echinoderms would carry more weight if he had worked out with thoroughness the complete life-history of any Echinoderm.

Lastly, I should like to protest against the idea that those interested in Echinoderms agree with the over-estimate of the importance of trifling peculiarities in the structure of pedicellariæ in which Dr. Mortensen indulges. As Dr. Bather says, they are of no use to the palæontologist, and Dr. Bather, who is not only a systematist, but also a first-class morphologist, will realise that Dr. Mortensen's views are accepted by few except himself.

E. W. MACBRIDE.

Royal College of Science, South Kensington, London, S.W.7, December 14.

PROF. MACBRIDE has allowed his enthusiasm for the truth, as he sees it, to blind his eyes to what I actually did say. I said the idea of alternation of generations, though recalled by Dr. Mortensen's account of an observation, was "not really justified." I also characterised Dr. Mortensen's own inference from that observation as "audacious." I am glad to find that Prof. MacBride agrees with me, even if his mode of expressing agreement be unusual.

I did not say that Dr. Mortensen had "shown" (which I take to mean "proved") those statements and conclusions concerning the Brachiolaria and its sucking disc to which Prof. MacBride takes exception. By using the expression "none the less" I meant to imply that his conclusion on this point was not on all-fours with his general conclusion. Prof. MacBride differs from me in the vigour with which he rubs in that argument. I am glad that my remark has aroused so doughty a champion to the defence of the Brachiolaria, but I confess that I am not as yet prepared to broider any published classification of the Asteroidea on my own banner.

It is not for me to break any lances in defence of Dr. Mortensen, but if Prof. MacBride is acquainted with Dr. Mortensen's "Studies in the Development of Crinoids" (see NATURE, vol. 107, p. 132, March 31, 1921) I am rather astonished that he should so belittle our Danish colleague's work on those lines. As for the importance that Dr. Mortensen attaches to pedicellariæ, I incline to think that it is his critics who "overestimate" it. He himself has written (1907, "Ingolf Exped., Echinoidea," vol. 2, p. 12):—"I have never stated that the classification has always to be based on the pedicellariæ as the most important factor; on the contrary, I am of opinion that where structural characters of some significance occur in the test, these are, upon the whole, of higher classificatory value than the characters in the pedicellariæ."

Prof. MacBride is as friendly and complimentary to me as he always is, even when we differ, but, however much he may differ from Dr. Mortensen, I do hope he realises that the latter has furnished us in this memoir with a number of novel observations obtained with labour and recorded with skill.

F. A. BATHER.

Some Problems in Evolution.

THE address of Prof. Goodrich on "Some Problems in Evolution," which I read in NATURE of November 24, incidentally deals in a slight but somewhat dogmatic manner with the question, "What share has the mind taken in evolution?" I do not propose myself to attempt to answer this question, but only to point out that the grounds on which Prof. Goodrich deals with the matter are quite inconsistent with well-established phenomena which are familiar to psychologists and psychotherapists.

Prof. Goodrich says, "I would maintain that there is no justification for the belief that it (mind) has acted, or could act, as something guiding or interfering with the course of metabolism." He scouts the idea "of the influence of the mind on the activities of the body," and says, "we cannot conceive how a physical process can be interrupted or supplemented by non-physical agencies." He tells us that the student of biology "should realise that the mental series of events lies outside the sphere of natural science," and relegates such matters to the realm of *philosophy*.

I have no doubt that Prof. Goodrich is familiar with recent advances in psychotherapy, and I cannot imagine how he reconciles them with the above statements. The treatise on "Suggestion and Autosuggestion," by Prof. Badouin, which describes the practice of the new Nancy school, gives plenty of examples of curative processes, which necessarily involve metabolism, set in motion by purely mental processes. A good example is furnished by the article of Prof. J. Stanley Gardiner in NATURE of December 15, p. 505. If autosuggestion can initiate metabolism in the individual, why is it to be ruled out as a possible factor in evolution? Prof. Goodrich is not an advocate of the view that only congenital characteristics can affect the progeny of the individual. If the requisite "environmental stimulus" persists I gather that in his opinion an acquired modification may also persist. In this connection it is surely a loss to his theory to rule out the effect which environment may produce primarily on the mind, and through the mind on metabolic processes. Why is the student of biology to regard all this as "outside the sphere of natural science"? W. R. BOUSFIELD.

IN answer to Mr. W. R. Bousfield's question I may say that he is mistaken if he thinks that I would deny the possibility of curative processes being set going by "suggestion." But I would maintain that suggestion is not a mental process. There is a popular error, widespread, that thought can be directly transferred, whereas, as a matter of fact, we know that one organism communicates with another by physical means through the organs of sense—by touch, smell, taste, sight, and hearing. Suggestion consists in bringing to bear appropriate stimuli which directly or indirectly set going certain metabolic processes; or, to put it in another way, the stimuli excite in the organism responses which from one aspect appear as a series of metabolic processes, and from another aspect as a series of mental processes. The one series cannot be altered without also altering the other.

IN NATURE of November 17 Dr. J. T. Cunningham complains that I have ignored "the greater part of all the new conceptions and new results obtained by recent research on heredity and genetics." Now it is difficult within the limits of a short address to guard against all possible misunderstanding, yet I think Dr. Cunningham might have gathered that my object was to concentrate on certain fundamental problems, avoiding all unnecessary detail. Although yielding to none in my admiration for the triumphs of Mendelism, I purposely set aside (as stated in a footnote) complications due to hybridisation, the formation of heterozygotes, segregation, etc., because they did not seem to me to bear directly on the questions discussed. My innocent statement "that the newest characters may be inherited as constantly as the most ancient, provided they are possessed by both parents," in no way contradicts Dr. Cunningham's own statement "that a character may be inherited when it is apparent only in one parent or in neither," a fact which, by the way, was known before Mendelism was invented. I still hope that nothing said in the address is inconsistent with even the newest sound conceptions and newest results of experimental genetics.

In the third paragraph of his letter, while seeming to agree that a change of character must be due either to an alteration of the germinal factors or of the environmental conditions, Dr. Cunningham confuses the issue by failing to distinguish consistently between the variation and the resulting character. This is just one of the important distinctions which, as I endeavoured to show in the address, must be realised if we are not to waste time in endless and futile controversy.

Great as is our debt to Weismann, it must be acknowledged that not a little of the confusion in discussions on "acquired characters" is traceable to obscurities and inconsistencies in his writings. In this matter I gladly acknowledge my indebtedness to the works of Sir Archdall Reid. No one, I think, has so clearly shown that, as some others saw before him, there are two kinds of variation, but only one kind of character. E. S. GOODRICH.

Oxford, December 9.

World List of Scientific Periodicals.

THE Conjoint Board of Scientific Societies proposes, if sufficient support is obtained, to arrange for the issue of a world list of periodical publications which contain the results of original scientific research, and has entrusted preliminary arrangements to a committee, of which the following are members:—Sir Sidney F. Harmer (chairman), Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Mr. A. W. Pollard, and Prof. W. W. Watts, secretary.

The list will be an octavo volume containing, in alphabetical order, the titles and places of publication of all such periodicals in existence on January 1, 1900, and of all issued after that date.

Libraries in London, Oxford, Cambridge, Edinburgh, Dublin, and Aberystwyth which take in these periodicals will be indicated in the list, and, wherever possible, at least one library in the United Kingdom will be indicated for each title.

The copies will be printed on one side only to facilitate alterations and additions.

The objects of the proposed volume are: (1) To supply as nearly as possible a complete list of current scientific periodicals; (2) to indicate, where possible, at least one library where each periodical is taken; (3) to form a basis for co-operation between libraries, so that both the number of duplicates and the list of periodicals not taken in may be reduced; and (4) to enable each library to use the list for its own purposes, by placing a mark against the title of each periodical it possesses, by cutting up for a card index, etc.

The trustees of the British Museum, recognising the importance of this work to scientific research and bibliography, have consented to allow the compilation to be undertaken by the staff of the Museum. They are unable, however, to defray the cost of printing and publication.

Although the value of a list of this kind to libraries and scientific societies would be very great, it is scarcely possible that the production of so costly a work would be entertained by a publishing firm as an ordinary commercial enterprise. If, however, a sufficient number of libraries and institutions agree in advance to purchase one or more copies, when issued, the compilation of the list will be put in hand at once. Already a large bulk of material has been collected in the British Museum by various societies and by the Conjoint Board.

I shall be glad to receive by January 31, if possible, the names and addresses of institutions or individuals who will support this proposal by undertaking to subscribe for one or more copies of the list. The price per copy will be 2*l.* 2*s.* net. W. W. WATTS.

Conjoint Board of Scientific Societies,
Burlington House, London, W.1.

Old Observations Bearing on the Duration of Sunrise.

IN 1769 the French academician Le Gentil went on a journey to Mauritius, Pondichéry, and Manila to

observe the transit of Venus and to study atmospheric refraction in the tropics. As an incident of the latter, while at Pondichéry he observed carefully the form of the rising sun, with attendant phenomena, and noted the instants of upper and lower contacts in several cases, with the help of the telescope of his quadrant and a clock. While he does not seem to have made any further use of the durations deducible from his observations, nevertheless with the help of the *Nautical Almanac* of that year and a standard astronomical formula one may compute the duration which would have held on the assumption of constant refraction, and may compare this with the actual observations and with the accompanying descriptions of the sun's form. The subjoined table shows the results. Type A (see *Popular Astronomy*, "On Types of Sunrise and Sunset," vol. 29, p. 251, 1921; NATURE, October 13, p. 211), which is a mirage type, has an average excess of +2·3 per cent. as compared with computation; the one type B case has an excess of +5·3 per cent. These results agree with numerous observations made by the present writer at various stations in Pacific and Atlantic waters. It is as if the sun sets behind a receding horizon and rises beyond an approaching horizon.

Local date, 1769	Duration Obs.	Comp.	Dif.	Per cent.	Type
	"	"	"		
I 7 A	148·5	144·6	+3·9	+2·8	A
I 9 A	147·4	144·4	+3·0	+2·1	A
I 10 A	145·0	144·1	+0·9	+0·6	A
II 1 A	145·4	139·7	+5·7	+4·1	A
VI 18 A	148·4	140·9	+7·5	+5·3	B

WILLARD J. FISHER.

The Measurement of Ionisation Currents by Three-electrode Valves.

IN view of the advantages offered by the use of valves for measuring ionisation currents, which have been pointed out in a recent paper by M. J. Malassez (*Comptes rendus*, vol. 172, p. 1093, 1921), it appears to be of some interest to describe another method of using valves for this purpose, differing in its application from that adopted by M. Malassez.

The method described by M. Malassez gives directly the mean ionisation during a certain interval of time by determining the time required to discharge a condenser from 40 volts to a small potential indicated sharply by the valve. It is intended to measure ionisation currents, of the order of 10^{-8} amperes, produced by X-rays when conditions are such that the leakage through the valve can be neglected.

In the method to be described the ionisation is measured by the steady deflection of a galvanometer. It permits changes of ionisation within short intervals of time to be followed, and can readily be adapted to a balance method.

The arrangement is given by the accompanying sketch (Fig. 1).

The plates of the valves V_1, V_2 are connected through equal resistances r_1, r_2. One terminal of each of these resistances is connected to the positive pole of the battery, the other terminals are connected through the galvanometer g. The resistances R_1, R_2 regulate the heating currents through the filaments. Each grid can be connected to the positive plate of an ionisation chamber through the leads C_1 or C_2.

The heating currents are set so as to give equal plate currents through both valves when the grids are insulated. When, owing to the action of the ionisation current, one of the grids receives a charge, the plate current through the corresponding valve is altered and the galvanometer is deflected. An ionisation current acting on the other filament causes a galvanometer deflection in the opposite direction.

The sensitiveness is, in general, different for ionisation currents acting on each of the grids, but for each one the deflections of the galvanometer are fairly proportional to the ionisation currents. If required, inequalities in the valves can be corrected by interposing an E.M.F. in one of the valve circuits by means of a battery and suitable resistances.

When two valves are used in this way, fluctuations in the heating currents and in the plate potentials are reduced owing to the fact that the heating currents for the filaments and the plate voltage are supplied from the same sources for both valves.

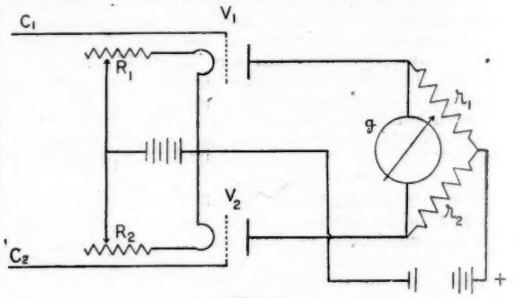


FIG. 1.

A fuller discussion of the method and more details of the experiments carried out will be given elsewhere.

When some radio-active deposit emitting α-rays is gradually brought near to an ionisation chamber of suitable shape it is easy to show the amount of ionisation for different distances (Bragg's curve) by the deflections of a unipivot galvanometer. When a more sensitive galvanometer is substituted for the unipivot instrument, in a set of observations the sensitivity for current was 3×10^{-13} amperes with a sensitivity for voltage of $1{\cdot}2 \times 10^{-4}$ volts, although the valves used were rather soft and not suitable for high current sensitivity, and no amplification device was used.

J. C. M. BRENTANO.

Manchester University, Manchester, December 10.

Simple Sensitive Flames.

IT does not seem to be well known that it is quite easy to make a very simple flame sensitive to sounds of short wave-length for working with gas at ordinary supply pressure.

Such a sensitive jet is obtained from a glass tube, of diameter about 1 cm., simply by rotating the end of the tube in a blow-pipe flame, so that it takes the shape of a dome with an orifice. This shape provides the sudden change of pressure on which sensitiveness depends. While the glass is still soft it is slightly flattened so as to make the orifice noticeably elliptical. As with high-pressure jets, the flame loses sensitiveness if the orifice be too nearly circular, or if its ellipticity be too great. The best condition is attained by trial. If the orifice be too large the flame is easily disturbed by draughts or by slight variations in the pressure of the gas. If it be too small the normal gas pressure is too low to give a flame on the point of flaring, a well-known condition of sensitiveness. These low-pressure flames are sensitive to lower pitched sounds than is usual with high-pressure flames. Like the latter, they are most sensitive to sounds in a particular direction, viz., the direction of the major axis of the elliptical orifice.

G. A. SUTHERLAND.

University College, W.C.1, December 6.

The Message of Science.[1]

BY SIR RICHARD GREGORY.

IT is just forty years ago, at the York Meeting in 1881, that a committee was appointed "to arrange for a conference of delegates from scientific societies to be held at the annual meetings of the British Association, with a view to promote the interests of the societies represented by inducing them to undertake definite systematic work on a uniform plan." The Association had been in existence for fifty years before it thus became a bond of union between local scientific societies in order to secure united action with regard to common interests. Throughout the whole period of ninety years it has been concerned with the advancement and diffusion of natural knowledge and its applications. The addresses and papers read before the various sections have dealt with new observations and developments of scientific interest or practical value; and, as in scientific and technical societies generally, questions of professional status and emolument have rarely been discussed. The port of science—whether pure or applied—is free, and a modest yawl can find a berth in it as readily as a splendid merchantman, provided that it has a cargo to discharge. Neither the turmoil of war nor the welter of social unrest has prevented explorers of uncharted seas from crossing the bar and bringing their argosies to the quayside, where fruits and seeds, rich ores and precious stones have been piled in profusion for the creation of wealth, the comforts of life, or the purpose of death, according as they are selected and used.

All that these pioneers of science have asked for is for vessels to be chartered to enable them to make voyages of discovery to unknown lands. Many have been private adventurers, and few have shared in the riches they have brought into port. Corporations and Governments are now eager to provide ships which will bring them profitable freights, and to pay bounties to the crews, but this service is dominated by the commercial spirit which expects immediate returns for investments, and mariners who enter it are no longer free to sail in any direction they please or to enter whatever creek attracts them. The purpose is to secure something of direct profit or use, and not that of discovery alone, by which the greatest advances of science have hitherto been achieved.

To the man of science discoveries signify extensions of the field of work, and he usually leaves their exploitation to prospectors who follow him. His motives are intellectual advancement, and not the production of something from which financial gain may be secured. For generations he has worked in faith purely for the love of knowledge, and has enriched mankind with the fruits of his labours; but this altruistic attribute is undergoing a change. Scientific workers are beginning to ask what the community owes to them, and what use has been made of the talents entrusted to it. They have created stores of wealth beyond the dreams of avarice, and of power unlimited, and these resources have been used to convert beautiful countrysides into grimy centres of industrialism, and to construct weapons of death of such diabolical character that civilised man ought to hang his head in shame at their use.

Mankind has, indeed, proved itself unworthy of the gifts which science has placed at its disposal, with the result that squalid surroundings and squandered life are the characteristics of modern Western civilisation, instead of social conditions and ethical ideals superior to those of any other epoch. Responsibility for this does not lie with scientific discoverers, but with statesmen and democracy. Like the gifts of God, those of science can be made either a blessing or a curse, to glorify the human race or to destroy it; and upon civilised man himself rests the decision as to the course to follow. With science as an ally, and the citadels of ignorance and self as the objective, he can transform the world, but if he neglects the guidance which knowledge can give, and prefers to be led by the phrases of rhetoricians, this planet will become a place of dust and ashes.

Unsatisfactory social conditions are not a necessary consequence of the advance of science, but of incapacity to use it rightly. Whatever may be said of captains of industry or princes of commerce, scientific men themselves cannot be accused of amassing riches at the expense of labour, or of having neglected to put into force the laws of healthy social life. Power—financial and political—has been in the hands of people who know nothing of science, not even that of man himself, and it is they who should be arraigned at the bar of public justice for their failure to use for the welfare of all the scientific knowledge offered to all. Science should dissociate itself entirely from those who have thus abused its favours, and not permit the public to believe it is the emblem of all that is gross and material and destructive in modern civilisation. There was a time when intelligent working men idealised science; now they mostly regard it with distrust or are unmoved by its aims, believing it to be part of a soul-destroying economic system. The obligation is upon men of science to restore the former feeling by removing their academic robes and entering into social movements as citizens whose motives are above suspicion and whose knowledge is at the service of the community for the promotion of the greatest good. The public mind has yet to understand that science is the pituitary body of the social organism, and without it there can be no healthy growth in modern life, mentally or physically.

This conference of delegates provides the most

[1] Abridged from the presidential address delivered to the Conference of Delegates of Corresponding Societies of the British Association at Edinburgh on September 8.

appropriate platform of all those offered by the British Association from which a message of exhortation may be given. There are now 130 corresponding societies of the Association, with a total membership of about 52,000, and their representatives should every year go back not only strong with zeal for new knowledge, but also as ministers filled with the sense of duty to inspire others to trust in it. In mechanics work is not considered to be done until the point of application of the force is moved; and knowledge, like energy, is of no practical value unless it is dynamic. The scientific society which shuts itself up in a house where a favoured few can contemplate its intellectual riches is no better than a group of misers in its relations to the community around it. The time has come for a crusade which will plant the flag of scientific truth in a bold position in every province of the modern world. If you believe in the cause of disciplined reason you will respond to the call and help to lift civilised man out of the morass in which he is now struggling, and set him on sound ground with his face toward the light.

It is not by discoveries alone, and the records of them in volumes rarely consulted, that science is advanced, but by the diffusion of knowledge and the direction of men's minds and actions through it. In these democratic days no one accepts as a working social ideal Aristotle's view of a small and highly cultivated aristocracy pursuing the arts and sciences in secluded groves and maintained by manual workers excluded from citizenship. Artisans to-day have quite as much leisure as members of professional classes, and science can assist in encouraging the worthy employment of it. This end can be attained by co-operative action between local scientific societies and representative organisations of labour. There should be close association and a common fellowship, and no suggestion of superior philosophers descending from the clouds to dispense gifts to plebeian assemblies. It should also always be remembered that a cause must have a soul as well as a body. The function of a mission-hall is different from that of a cinema-house or other place of entertainment, and manifestations of the spirit of science are more uplifting than the most instructive descriptive lectures.

Science needs champions and advocates in addition to actual makers of new knowledge and exponents of it. There are now more workers in scientific fields than at any other time, yet relatively less is done to create enthusiasm for their labour and regard for its results than was accomplished fifty years ago. Every social or religious movement passes through like stages, from that of fervent belief to formal ritual. In science specialisation is essential for progress, but the price which has to be paid for it is loss of contact with the general body of knowledge. Concentration upon any particular subject tends to make people indifferent to the aims and work of others; for, while high magnifying powers enable minute details to be discerned, the field of vision is correspondingly narrowed, and the relation of the structure as a whole to pulsating life around it is unperceived.

As successful research is now necessarily limited for the most part to complex ideas and intricate details requiring special knowledge to comprehend them, very special aptitude is required to present it in such a way as will awaken the interest of people familiar only with the vocabulary of everyday life. In the scientific world the way to distinction is discovery, and not exposition, and rarely are the two faculties combined. Most investigators are so closely absorbed in their researches that they are indifferent as to whether people in general know anything of the results or not. But where one person will exercise his intelligence to understand the description of a new natural fact or principle a thousand are ready to admire the high purpose of a scientific quest and reverence the disinterested service rendered by it to humanity. The record of discovery or description of progress is, therefore, only one function of a local scientific society; beyond this is the duty of using the light of science to reveal the dangers of ignorance in high as well as in low places. Though in most societies there is only a small nucleus of working members, the others are capable of being interested in results achieved, and a few may be so stimulated by them as to become just and worthy knights of science, ready to remove any dragons which stand in the way of human progress, and continually upholding the virtues of their mistress.

Every local scientific society should be a training ground for these Sir Galahads, and an outpost of the empire of knowledge. The community should look to it for protection from dangers within and without the settlement, and for assistance in pressing further forward into the surrounding woods of obscurity. At present it is unusual for this civic responsibility to be accepted by a scientific society, with the result that local movements are undertaken without the guidance necessary to make them successful. A local scientific society should be the natural body for the civic authority to consult before any action is taken in which scientific knowledge will be of service. It should be to the city or county in which it is situated what the Royal Society is to the State, and not a thing apart from public life and affairs.

When wisdom is justified of her children, and local scientific societies are no longer esoteric circles, but effective groups of enlightened citizens of all classes, they will provide the touchstone by which fact is distinguished from assertion and promise from performance. As the sun draws into our system all substantial bodies which come within its sphere of influence, while the pressure of sunlight drives away the fine dust which would tend to obscure one body from another, so a local scientific society possesses the power of attracting within itself all people of weight in the region around it and of dispersing the mist and fog which commonly prevail in the social atmo-

sphere. Thus may the forces of modern civilisation, moral and material, be brought together, and an allied plan of campaign be instituted against the armies of ignorance and sloth. The service is that of truth, the discipline that of scientific investigation, and the unifying aim human well-being. Kingsley long ago expressed the democratic basis upon which this fellowship is founded; and when he delivered his message artisans were crowding in thousands in Manchester and other populous places to lectures by leaders in the scientific world of that time. Labour then welcomed science as its ally in the struggle for civil rights and spiritual liberty. That battle has been fought and won, and subjects in bitter dispute fifty years ago now repose in the limbo of forgotten things.

There is no longer a conflict between religion and science, and labour can assert its claims in the market-place or council house without fear of repression. Science is likewise free to pursue its own researches and apply its own principles and methods within the realm of observable phenomena, and it does not desire to usurp the functions of faith in sacred dogmas to be perpetually retained and infallibly declared. The Royal Society of London was founded for the extension of *natural* knowledge in contra-distinction to the *supernatural*, and it is content to leave other philosophers to describe the world beyond the domain of observation and experiment. When, however, phenomena belonging to the natural world are made subjects of supernatural revelation or uncritical inquiry, science has the right to present an attitude of suspicion towards them. Its only interest in mysteries is to discover the natural meaning of them. It does not need messages from the spirit world to acquire a few elementary facts relating to the stellar universe, and it must ask for resistless evidence before observations contrary to all natural law are accepted as scientific truth. If there are circumstances in which matter may be divested of the property of mass, fairies may be photographed, lucky charms may determine physical events, magnetic people disturb compass needles, and so on, by all means let them be investigated, but the burden of proof is upon those who believe in them and every witness will be challenged at the bar of scientific opinion.

We do not want to go back to the days when absolute credulity was inculcated as a virtue and doubt punished as a crime. It is easy to find in works of uncritical observers of medieval times most circumstantial accounts of all kinds of astonishing manifestations, but we are not compelled to accept the records as scientifically accurate and to provide natural explanations of them. We need not doubt the sincerity of the observer even when we decline to accept his testimony as scientific truth. The maxim that "seeing is believing" may be sound enough doctrine for the majority of people, but it is insufficient as a principle of scientific inquiry. For thousands of years it led men to believe that the earth was the centre of the universe, with the sun and other celestial bodies circling round it, and controlling the destiny of man, yet what seemed obvious was shown by Copernicus to be untrue. This was the beginning of the liberation of human life and intellect from the maze of puerile description and philosophic conception. Careful observation and crucial experiment later took the place of personal assertion and showed that events in Nature are determined by permanent law and are not subject to haphazard changes by supernatural agencies. When this position was gained by science, belief in astrology, necromancy, and sorcery of every kind began to decline, and men learned that they were masters of their own destinies. The late war is responsible for a recrudescence of these medieval superstitions, but if natural science is true to the principles by which it has advanced it will continue to bring to bear upon them the piercing light by which civilised man was freed from their baleful consequences.

There is abundant need for the use of the intellectual enlightenment which science can supply to counteract the ever-present tendency of humanity to revert to primitive ideas. Fifty years of compulsory education are but a moment in the history of man's development, and their influence is as nothing in comparison with instincts derived from our early ancestors and traditions of more recent times grafted upon them. So little is known of science that to most people old women's tales or the unsupported words of a casual onlooker are as credible as the statements and conclusions of the most careful observers. Where exact knowledge exists, however, to place opinion by the side of fact is to blow a bubble into a flame. Within its own domain science is concerned not with belief—except as a subject of inquiry—but with evidence. It claims the right to test all things in order to be able to hold fast to that which is good. It declines to accept popular beliefs as to thunderbolts; living frogs and toads embedded in blocks of coal or other hard rock without an opening, though the rock was formed millions of years ago and all fossils found in it are crushed as flat as paper; the inheritance of microbic diseases; the production of rain by explosions when the air is far removed from its saturation point; the influence of the moon on the weather or of underground water upon a twig held by a dowser, and dozens of like fallacies, solely because when weighed in the balance they have been found wanting in scientific truth. Its only interest in mysteries is that of inquiring into them and finding a natural reason for them. Mystery is thus not destroyed by knowledge but removed to a higher plane.

Never let it be acknowledged that science destroys imagination, for the reverse is the truth. "The Gods are dead," said W. E. Henley,

> "the world, a world of prose,
> Full-crammed with facts, in science swathed and sheeted,
> Nods in a stertorous after-dinner doze!
> Plangent and sad, in every wind that blows
> Who will may hear the sorry words repeated:—
> 'The gods are dead.'"

It is true that the old idols of wood and stone are gone, but far nobler conceptions have taken their place. The universe no longer consists of a few thousand lamps lit nightly by angel torches, but millions of suns moving in the infinite azure, into which the mind of man is continually penetrating further. Astronomy shows that realms of celestial light exist where darkness was supposed to prevail, while scientific imagination enables obscure stars to be found which can never be brought within the sense of human vision, the invisible lattice work of crystals to be discerned, and the movements of constituent particles of atoms to be determined as accurately as those of planets around the sun. The greatest advances of science are made by the disciplined use of imagination; but in this field the picture conceived is always presented to Nature for approval or rejection, and her decision upon it is final. In contemporary art, literature, and drama imagination may be dead, but not in science, which can provide hundreds of arresting ideas awaiting beautiful expression by pen and pencil. It has been said that the purpose of poetry is not truth, but pleasure; yet, even if this definition be accepted, we submit that insight into the mysteries of Nature should exalt, rather than repress, the poetic spirit, and be used to enrich verse, as it was by some of the world's greatest poets—Lucretius, Dante, Milton, Goethe, Tennyson, and Browning. With one or two brilliant exceptions, popular writers of the present day are completely oblivious to the knowledge gained by scientific study, and unmoved by the message which science is alone able to give. Unbounded riches have been placed before them, yet they continue to rake the muck-heap of animal passions and stir the froth of sloppy sentiment for themes of composition. Not by their works shall we become "children of light," but by the indomitable spirit of man ever straining upwards to reach the stars.

Where there is ignorance of natural laws all physical phenomena are referred to supernatural causes. Disease is accepted as Divine punishment to be met by prayer and fasting, or the act of a secret enemy in communion with evil spirits. Because of these beliefs thousands of innocent people were formerly burnt and tortured as witches and sorcerers, while many thousands more paid in devastating pestilences the penalty which Nature inevitably exacts for crimes against her. In one sense it may be said that the human race gets the diseases it deserves; but the sins are those of ignorance and neglect of physical laws rather than against spiritual ordinances. Plague is not now explained by supposed iniquities of the Jews or conjunctions of particular planets, but by the presence of an organism conveyed by fleas from rats; malaria and yellow fever are conquered by destroying the breeding places of mosquitoes; typhus fever by getting rid of lice; typhoid by cleanliness; tuberculosis by improved housing; and most other diseases by following the teachings of science concerning them. Though the mind does undoubtedly influence the resistance of the body to invasion by microbes, it cannot create the specific organism of any disease, and the responsibility of showing how to keep such germs under control, and prevent, therefore, the poverty and distress due to them, is a scientific rather than a spiritual duty.

The methods of science are pursued whenever observations are made critically, recorded faithfully, and tested rigidly, with the object of using conclusions based upon them as stepping-stones to further progress. They demand an impartial attitude towards evidence and fearless judgment upon it. These are the principles by which the foundations of science have been laid, and a noble structure of natural knowledge erected upon them. A scientific inquiry is understood to be one undertaken solely with the view of arriving at the truth, and this disinterested motive will always command public confidence. It is poles apart from the spirit in which social and political subjects are discussed: it is the rock against which waves of emotion and storms of rhetoric lash themselves in vain. If political science were guided by the same methods it would present an open mind to all sides of a question, weighing objections to proposals as justly as reasons in support of them, whereas usually it sees only the views of a particular class or party, and cannot be trusted, therefore, to strike a judicial balance. The methods of science should be the methods applied to social problems if sound principles of progress are to be determined. When they are so used a statesman will be judged, as a scientific man is judged, by correct observation, just inference, and verified prediction; in their absence politics will remain stranded on the shifting sands of barter, concession, and expediency.

Local scientific societies should provide a common forum where workers with hand or brain can meet to consider new ideas and discuss judicially the significance of scientific discovery or applied device in relation to human progress. At present such societies are mostly out of touch with these practical aspects of knowledge, and are more interested in prehistoric pottery than in the living world around them. Most of those connected with the British Association are concerned with natural history, but all scientific societies in a district should form a federation to proclaim the message of knowledge from the house-tops. Men are ready to listen to the gospel of science and to believe in its power and its guidance, but its disciples disregard the appeal and are content to let others minister to the throbbing human heart. Civilisation awaits the lead which science can give in the name of wisdom and truth and unprejudiced inquiry into all things visible and invisible, but the missionary spirit which would make men eager to declare this noble message to the world has yet to be created.

This is as true of the British Association itself as it is of local scientific societies. It seems to

be forgotten that one of the functions of the Association is to inspire belief and confidence in science as the chief formative factor of modern life, and not only to display discoveries or enable specialists to discuss technical advances in segregated sections. Though members of the Association may be able to live on scientific bread alone, most of the community in any place of meeting need something more spiritual to awaken in them the admiration and belief which beget confidence and hope. They ask for a trumpet-call which will unite the forces of natural and social science, and are unmoved by the parade of trophies of scientific conquests displayed to them. It was the primary purpose of Canon W. V. Harcourt, the chief founder of this Association and its general secretary from 1831 to 1837, to sound this note for "the stimulation of interest in science at the various places of meeting, and through it the provision of funds for carrying on research," and not for "the discussion of scientific subjects in the sections." In the course of time these sectional discussions have taken a prominent place in the Association's programme, and rightly so, for they have promoted the advancement of science in many directions; but, while we recognise their value to scientific workers, we plead for something more for the great mass of people outside the section-rooms, for a statement of ideals and of service, of the strength of knowledge and of responsibility for its use. These are the subjects which will quicken the pulse of the community and convert those who hate and fear science and associate it solely with debasing aspects of modern civilisation into fervent disciples of a new social faith upon which a lever made in the workshops of natural knowledge may be placed to move the world.

Integration in the Living Organism.

By PROF. W. M. BAYLISS, F.R.S.

THE name "organism," given to the individual units of living matter as they are met with in Nature, implies that these act as unified and co-ordinated entities. At the same time, it must be remembered that an organism considered apart from its environment is merely a theoretical abstraction; but, apart from the way in which they react to external influences, there must be means by which the activity of any one part is adjusted to the needs of the whole, and the investigation of these various means may be said to form a large part of modern physiology. In a general sense, it may be looked upon as distinctive of the more recent outlook, for most of us are not content with ascribing the mutual co-ordination of function to a presiding directive agency, be it called "entelechy," "élan vital," or other mysterious influence. We want to know more of the actual chemical and physical methods at work in the process, and we believe that it is possible to find out a great deal more about them than we know as yet. The change in the point of view of the physiologist may be realised better if we call to mind that it is no longer thought scientific to devote attention to the "functions of the liver," for example, but to those processes, such as deamination and regulation of carbohydrate supply, in which this organ plays a part in combination with various other tissues of the organism. We ask: What part does the liver play in the correlated series of changes associated with the using up of the materials of the food for the supply of energy to, and for the growth of the cells of, the organism as a whole?

Broadly speaking, there are two great "systems"—to use a term which is rather antiquated in this sense—that serve as the means of communication between different parts of the higher animals—the nervous system and the vascular system. There are corresponding means of communicating by messages or by actual transport of materials in the higher plants. As a first approximation, we may call the former physical and the latter chemical. These correspond to the "nervous" and "humoral" factors of the French physiologists. The central nervous system, in addition to its obvious function of receiving impressions from the outer world and reacting upon it by reflexes to muscles, obtains messages from the various parts of the organism itself by means of appropriate receptors therein. Thus "effectors"—muscles, glands, etc.—are modified in their activity, and the special requirements of active organs are met. For example, an active secreting gland receives an increased supply of blood, containing sugar and oxygen, by dilatation of the blood vessels to it. By the blood, or similar circulating liquid, a chemical substance made in one place is carried over the whole of the organism, and in special places adjusted to be sensitive to it brings about appropriate reactions, which may affect a large number of other organs. Thus the carbon dioxide produced in active muscles reaches the respiratory nervous centre, exciting this to increase the ventilation of the lungs and supply more oxygen to the muscles by means of the blood.

The comparison of the nervous system to the telegraphic circuits of a city has often been made, and is probably more to the point than is sometimes thought, since there are many reasons for supposing that the passage of impulses along nerves is essentially of an electrical nature. The vascular system may similarly be compared to mechanical transport, by which coal, for instance, is conveyed in carts. In this latter case, material substances are sent from place to place. Perhaps a closer analogy to the blood vessels with their

pump, the heart, would be the distribution of water in pipes; but everyday experience reminds us that there is also a postal system by means of which actual material bodies convey *messages*. Thus a letter can order a supply of coal or cut off the electric current. The "chemical messengers" or "hormones" are the letters of the living organism. When the acid contents of the stomach pass into the intestine a chemical compound of unknown constitution is formed in the cells lining this tube, passes into the blood, and ultimately arrives at the pancreas, the cells of which alone of all those with which the blood comes into contact are able to respond to its stimulus. This they do by secreting pancreatic juice. The hormone, called "secretin," merely to give it a name, is a letter sent to the pancreas by the food asking for the enzymes needed to digest it. It does not serve in any sense as food for the cells, it is not a part of the secretion, but sets the machinery to work.

The fact must not be overlooked, however, that these various means of integration act together. Just as coal can be ordered by telegram, so a supply of sugar or oxygen can be ordered by a nervous message sent by an active organ, and we have already seen that a chemical messenger (=a letter) can excite the respiratory centre to send nervous impulses (=telegraphic messages) to the muscles producing respiratory movements. In general, co-ordination by chemical means is apt to be of a more prolonged or continuous nature than that by nervous reflexes. Even in the latter case, however, it is very common to find that an organ is under the continuous control of both excitatory and inhibitory nerves, the two opposing influences being in action at the same time. Any particular state is thus the expression of a preponderance on one or the other side of the balance. The fact has been made clear in the tone of the stomach of some reptiles, but it appears to be of wide occurrence, if not a general law.

The internal secretions of the endocrine glands are to be included in the category of chemical messengers. An interesting and instructive article by Prof. Strohl, of Zürich, was published in the *Revue générale des Sciences* (May 15, 1921), and, in point of fact, suggested the present remarks. His article deals with the general biological significance of the internal secretions, and contains a full list of papers, including those concerning lower animals. The author compares hormones to the electric waves of wireless telegraphy, since only certain tissues are tuned to respond to them. I venture to think that the postal system is a better illustration. Actual material bodies are carried, and these "letters" are accepted only at the correct addresses. In many cases, such as those of the suprarenal bodies and the thyroid gland, we are able to assign the function in question definitely to particular organs, which, indeed, appear to possess no other function.

In other cases, more difficulty is met with, owing to the fact that the cells producing the internal secretion are mixed up with cells having other known functions. Such, for example, is the case with the "islets of Langerhans," embedded in the pancreatic tissue which secretes the digestive juice. There is evidence that these "islets" produce a hormone which is required for the due utilisation of sugar. This co-existence, side by side, of cells with different functions is only one of the many difficulties met with in the study of internal secretions. It appears that removal of one particular endocrine organ affects the functions of those that are left. Indeed, the complexity of the phenomena may be some excuse for the contradictory and hazy statements so often made by workers on the problem, and for the hasty and sensational "discoveries" announced from time to time in the Press. This aspect of the subject is rightly emphasised by Gley in his valuable lectures on "Les Sécrétions Internes," where it is pointed out that clear and definite statements are much to be desired. Names are too often given which, although they profess to explain, are nothing but descriptions of the facts in other words. No advance is possible in this way.

The existence of certain organs or tissues which, so far as can be made out, have no function other than that of making chemical compounds for the purpose of acting on other tissues suggests the question whether those tissue cells which have obvious functions of another kind do not also give out to the blood substances which act in other places—whether the view of Brown-Séquard that all tissues make internal secretions may not be correct. In the simple case of carbon dioxide this is, of course, the case; but it is possible that many of the chemical products of the activity of cells may be inert for want of receptive cells sensitive to them. Many substances found in animals and plants appear to be waste products of metabolism—as, for example, the great variety of alkaloids met with in plants. There is evidence that some influence is exerted by cells on the growth and nature of cells of other kinds in their neighbourhood. The experiments of Champy may be cited as examples of this influence; moreover, fragments of differentiated tissue grown on a slide under the microscope are apt to lose their distinctive marks as they proliferate, and to become of an embryonic type. If, however, the fragment contains both epithelium and connective tissue, the new epithelial cells retain the characters of those from which they arise, so long as they remain in proximity to the connective tissue; but if they wander away they lose their identity and become generalised in aspect. Similarly, the excessive outgrowth of connective tissue in retinal fragments is held in check by the presence of nerve cells. It seems that the normal growth of tissue cells is only possible when under the "control" of other cells. This circumstance is significant in relation to the problem of malignant growths. Champy describes a

case of a particular tumour which was found on removal to be only in part malignant, but when a culture was made of the epithelium of the normal part the cells, deprived of the influence of their surrounding tissues, gave rise to daughter-cells similar to those of the malignant growth.

Again the power of survival of transplanted organs shows how complex is the variety of factors distinguishing one individual from another even within the same species. Prof. Leo Loeb has made a large number of experiments of this kind in the United States, and finds, in agreement with other workers, that tissues transplanted into another species die more or less rapidly; if put into another individual of the same species they also die in the end, but not so soon as in the first case. If simply moved into another part of the body of the same individual they survive and grow. In some cases they may survive in the body of an individual closely related to that from which the tissue was taken—as, for example, a brother. Now while Prof. Loeb assumes that the results are chiefly due to the giving off by the cells of specific chemical entities which differ from individual to individual, we must remember that we have no actual proof of this. It is perhaps well to be cautious until the specific properties are shown to be of a chemical nature. An interesting fact is that the specificity spoken of reaches this high state of development only in the higher vertebrates, and is much less manifest in their embryonic stages.

The hypothesis that all constituent cells of an organism give off internal secretions is clearly at the basis of hormone theories of heredity, such as that associated with the name of J. T. Cunningham. However inaccessible to influence of other kinds, it cannot be denied that the germ-plasm must be exposed to the action of substances in solution in the blood. The experiments of Stockard show that the germ-plasm in guinea-pigs is altered for several generations by the action of alcohol on the original parents. The removal of an organ, such as the tail, containing merely tissues abundantly present elsewhere would not be expected, on this hypothesis, to have any effect capable of hereditary transmission.

The internal secretions, especially those affecting growth, have an obvious resemblance to the accessory food factors or vitamins; but these have to be supplied to animals from the outside, ultimately from vegetable food, since plants only are able to make them. In neither case, however, do we know the chemical nature of the substance concerned. It may turn out that we have to do with minute traces of metallic elements, perhaps some of the rare metals. In that connection we are reminded of the necessity for zinc, in extremely small amounts, for the optimal growth of the mould Aspergillus. Certain of the endocrine organs may, indeed, have the function of supplying in an active or utilisable form some particular element, as appears to be the case with the thyroid gland in relation to iodine.

"Leader" Cables for Aircraft.

FOR some time past experiments have been in progress in adapting to the purposes of aerial navigation the "leader" cable system now successfully used in connection with shipping. Various tests made in this country revealed that a marine installation is of little use to aircraft, as no signals were received from the cable whilst an aeroplane was over the submerged part of it. But when the land portion of the cable was reached the signals it gave out were heard easily in the machine through an ordinary telephonic receiver. If the cable be laid above ground, or suspended from poles, the "leader" system can be employed as successfully to guide aircraft as to guide shipping. The principle is the same in each case, though some modifications in applying it are necessary.

So far as England is concerned, we do not appear to have gone much beyond demonstrating the fact that a "leader" cable for aircraft is a practical proposition. But Lieut. Loth, of the French navy, after devoting a considerable period to investigating the subject, has devised an aircraft "leader" cable which proved highly successful when tried at the Villacoublay aerodrome. This officer is well known for his work in connection with such cables, as he was largely responsible for laying the marine installation at Brest. His aerial apparatus follows closely upon the lines of that employed in ships. Three receiving coils are fixed on the aeroplane, and the pilot takes in signals by means of "listeners," or ear-pieces, in his helmet. When the machine is flying directly above, or parallel to, the cable a strong signal is transmitted to the pilot through the centre coil, and this continues so long as the cable is being "followed." The other coils indicate when the machine is to right or left of the cable, and enable the pilot to "pick up" the installation. Signals can be heard at an altitude of 10,000 ft. and for a mile and a half on either side of the cable.

In the case of a submarine cable, the area over which sound can be heard is necessarily limited, because a good deal of energy is expended in producing currents in sea water. In the air no such loss of energy occurs, and therefore the sound-range can be very materially increased. "Leader" cables fulfil the same function in relation to aircraft as to seacraft by enabling them to find their way home in thick weather or in the dark, and by adopting the system the practice of lighting flares on aerodromes is made unnecessary.

War Work of the Bureau of Standards, U.S.A.[1]

THE value of science to the belligerent countries was proved over and over again during the war—in the United States no less than in other countries. The United States, however, had the advantage over other countries in this as in other matters, that, before it joined in the fighting, many lessons had been learned or, at least, were in course of being learned, and of these by no means the least was the fact that scientific workers could render enormous service to the combatant forces. We find, therefore, that, from the very moment of America's entry into the war, the services of the Bureau of Standards were made use of in connection with the many problems which arose. The volume before us is a record of some of these activities, although, as is pointed out, some of the most interesting and important of the investigations carried out cannot be described owing to military or other reasons. Moreover, at the Bureau, as at our National Physical Laboratory, a great deal of the assistance rendered took the form of oral advice and consultations, the value of which cannot be estimated, and most of which was not of a nature to become part of the permanent records. In spite of these facts, so much work was carried out that the present volume is, perforce, little more than a series of brief abstracts of the many investigations undertaken, and it is possible in a review to pick out only a few of the more interesting of these and to refer briefly to them.

It is only natural that aeronautics should occupy a prominent place in the activities of the Bureau, and the report opens with a description of the work accomplished on aeronautical instruments. Many were designed at the Bureau, where provision was made to give thorough laboratory tests to 4 per cent. of the total production of the country. These tests included experiments carried out in temperature chambers and on vibration stands, so that the instruments might be subjected to the same conditions as would be encountered in actual use.

Of very great interest is the "altitude laboratory." This consists of a concrete chamber with walls capable of withstanding a considerable pressure from without. Within this chamber the engine under test is mounted and tested under varying conditions of temperature and pressure, it being possible to reduce the latter to as low as one-third of an atmosphere—corresponding to an altitude of 35,000 ft.

Exhaustive tests on ignition systems for aeroplane engines were also carried out, the majority on the sparking-plugs—or spark-plugs, as the Americans term them. The conditions to which these plugs are subjected in aero-engines are much more severe than in ordinary motor-car practice. The pressure inside the cylinders may amount to 600 lb. per square inch, and during operation the sparking-plug is exposed alternately to a blast of air which may be at a temperature well below zero, and to a flame of burning petrol, the temperature of which is estimated at 2500° C. As a result of research, several porcelains have been obtained, which have high electrical resistance and mechanical strength while hot, and are capable of withstanding sudden temperature changes; they have been largely used in the manufacture of sparking-plugs in the States. In addition to the work on the insulating material of the plugs, brittleness occurring in nickel electrodes has been investigated, and cements for fixing the electrode in the insulator have been studied.

A delightfully simple form of gauge for measuring the tension of aeroplane wires was designed at the Bureau. The wire is supported on two pins at a known distance apart, and loaded, by means of hand levers, at the middle of the span thus formed. The load is measured by means of one Ames dial, and the deflection of the wire by another. The dials are calibrated so that it is possible to read off the tension directly when the wire is deflected 0·1 in.

Reference must also be made to the work on dopes for aeroplane fabrics. These may be divided into two classes, cellulose nitrate dopes and cellulose acetate dopes. The former are highly inflammable, and therefore undesirable. Before the war America obtained all her cellulose acetate from the Bayer Company of Germany, and it was not until after seven months of war that provision was made for securing an adequate supply of raw material. In the meantime, the United States had been reduced to such devices as obtaining cuttings and scraps of kinema films in order to manufacture sufficient quantities of dope.

Leaving the aeronautical side of the report, and turning to the section headed "Gauges" (or rather "Gages"), one is impressed with the small amount of work done at the Bureau compared with what was done at the National Physical Laboratory. It appears that the total number of gauges tested at the Bureau and its branch laboratories was 60,000. This is about the average number tested in two months between 1915 and 1918 at the National Physical Laboratory, and about the average in six weeks during 1917–18.

Very interesting reading is furnished by the section on invisible signalling. In this connection a number of experiments were made, using both ultra-violet and infra-red radiations. It was found that the former were liable to fail owing to a fluorescence which was produced in the eye of the enemy observer—particularly if he were young. Infra-red rays, on the other hand, gave more promising results, but, as no methods are known for detecting them unless one is in the direct line of "sight," it is a moot question whether the method should be developed further.

It may seem a far cry from the study of ultra-

[1] "War Work of the Bureau of Standards." Pp. 299. (Washington: Government Printing Office.) 70 cents.

violet light for the purposes of invisible signalling to the investigation of sole leather for boots, but the report being arranged alphabetically, they come in close proximity therein. Perhaps this is well, for it indicates the widespread activities of the Bureau. Not only were the wearing properties of various soles, made of both leather and composition, tested, but a radiographic study of the clinching of the nails used in repairing the soles was also undertaken.

The work of the metallurgical department ranged between such widely different problems as the investigation of nails for horse-shoes and the study of gold-palladium alloys as substitutes for platinum. As is to be expected, the study of light (aluminium) alloys, largely in connection with aircraft requirements, occupies a prominent place. It is stated that the work to date has shown the superiority of alloys containing either copper and zinc or magnesium and copper as additions to aluminium, and it is of interest to note that the Bureau concentrated on magnesium-copper-aluminium alloys because the National Physical Laboratory was, at the time, investigating copper-zinc-aluminium alloys. In connection with these materials attention must be directed to the curious phrase referring to "the French alloy Duralumin," while later Wilm is correctly referred to as the discoverer of the hardening of this alloy after heat treatment.

Another use to which an aluminium alloy was put was for the manufacture of mirrors of high reflecting power, it being found that the compound Al_3Mg_4, containing 50 per cent. of magnesium, gave a reflection of .85 per cent. in the blue and 93 per cent. in the red portions of the spectrum, though such mirrors are not recommended where permanency is of prime importance. It may be of interest to note that the recent work of Hanson and Gayler, at the National Physical Laboratory, throws considerable doubt on the existence of this compound.

Amongst the many other metallurgical researches undertaken, two may be selected for mention; one is an investigation on the welding of steel, and the other a series of tests on different compositions of bearing metals.

The production and testing of optical glass are other branches of the activities of the Bureau which call for special mention. The manufacture was commenced in 1914–15—before America declared war—and in 1917 a large furnace holding a 1000-lb. pot was built, in which glass was produced on a commercial scale, and very satisfactory results were obtained.

Brief reference only can be made to other investigations described in the report. The photographic work, especially illustrating a view taken from an aeroplane through a haze, (1) on an ordinary plate, and (2) on a plate specially prepared at the Bureau, is of great interest. A very large amount of work on radio-communication, including special investigations on direction-finding and on signalling from submerged submarines, is also described. Investigations on rubber for tyres, insulated wire, etc., and work on sound-ranging and on sound transmitted through the earth, which was a development of British and French methods, also deserve mention. Work on textiles covers a very wide range of subjects, including some research on dye-stuff chemistry. Finally, there is the work on X-rays, which, however, was not initiated until 1917.

The Bureau of Standards is to be congratulated, not only on the immense amount of useful war work which it has carried out, but also on the interesting manner in which it has presented the summary of this work to the public.

J. L. H.

Obituary.

THE RIGHT HON. LORD LINDLEY, P.C., F.R.S.

THE name of the Right Hon. Lord Lindley, whose death, in his ninety-fourth year, occurred at East Carlton, Norwich, on December 9, will long be remembered as that of a distinguished lawyer and a great judge. The features in Lord Lindley's judgments which arrested attention were themselves due to the remarkable scientific instinct with which they were imbued. This quality may have been inherited, for the same independence and sagacity, displayed in another sphere, mark the writings of Lord Lindley's father, Dr. John Lindley, F.R.S., professor of botany at University College, and for many years the editor and principal proprietor of the *Gardeners' Chronicle*.

The constant intercourse between Prof. Lindley and Sir William Hooker, director of Kew during 1841–65, brought young Lindley into contact with Dr. (afterwards Sir Joseph) Hooker, assistant director of Kew from 1855, and Sir William's successor in the directorship during 1865–85. The fast friendship and constant correspondence thus initiated ended only with the death of Sir Joseph in 1911. This correspondence, it is fair to state, rarely related to technical botanical subjects. On the contrary, it indicates rather that Lindley and Hooker, who often consulted each other on important matters of business, each placed implicit reliance on the judgment of the other as to questions which concerned their own particular activities. But while it is doubtless true that the keen interest which Lord Lindley, throughout his long life, took in botanical pursuits was strengthened by his friendly relationship with Sir Joseph Hooker, it is unquestionable that it had its foundation in his admiration for, and sympathy with, his father's work. His interest led to intimate intercourse with other prominent contemporary botanists, notably with the late Mr. George Bentham, joint-author with Sir Joseph Hooker of that remarkable work, the "Genera Plantarum."

Equally keen throughout his life was the sym-

pathy displayed by Lord Lindley towards every effort to apply scientific methods in practical horticulture. This interest, too, is to be traced to his early admiration of the labours of his father in this field, though the continuance of that interest, in the midst of his professional and judicial preoccupations, may have been strengthened by the inheritance of Prof. Lindley's proprietary rights in the *Gardeners' Chronicle*. In the fortunes and the management of that important journal Lord Lindley was to the last keenly interested.

In recognition of the estimation in which his judicial eminence was held, the University of Oxford conferred on Lord Lindley the degree of D.C.L.; the Universities of Cambridge and Edinburgh both conferred on him that of LL.D. After he became a Lord Justice of Appeal his botanical friends, who were in a position to estimate his scientific as contrasted with his legal attainments, begged him to allow them to propose his name for election to the Royal Society. To this proposal Lindley declined to agree, on the ground that he was not a scientific worker and had no claim to be regarded as a patron of science. But the appointment of Lindley in 1897 to the Mastership of the Rolls gave the society an opportunity, which it took early in the following year, of electing him F.R.S. under a statute which at that time empowered them to do this in the case of any member of the Privy Council, so that this distinction, too, at least in form, was academic rather than scientific, though it was one worthily bestowed whether on academic or on scientific grounds.

We regret to announce the death on Saturday, December 17, of Dr. T. A. Chapman at the age of seventy-nine years. Dr. Chapman, who was the author of numerous papers on entomology and other branches of natural history, was elected a fellow of the Royal Society in 1918.

Notes.

Those interested in bibliographical research will be glad to learn that the proposals made in Nature of June last (vol. 107, p. 449) for the compilation of a Union List of Current Research Serials under the direction of the British Museum authorities have not fallen on barren ground. We trust that the appeal from the Conjoint Board of Scientific Societies, which appears in our correspondence columns, will meet with hearty and generous support from all copyright, State, and professional librarians, as well as from the larger rate-supported libraries. The action of the British Museum authorities in placing the services of their staff at the disposal of British science is specially noteworthy, and is of good augury for the future relations of literature and science. In one respect the scheme now submitted is an improvement upon our own, for the proposed list will include serials in existence on, or issued since, January 1, 1900. This will link up the list with those prefixed to the Subject Catalogues on Mathematics, Mechanics, and Physics for 1800–1900 published by the Royal Society. The existence of these lists should not be overlooked in the compilation of the present one. On the other hand, the proposal to include in the new list serials not available for reference in the United Kingdom may be thought of doubtful value and practicability. A Union List for Germany is already in existence, and a similar list for the United States is in preparation. The circulation of a list of these unrepresented periodicals through the research libraries should, however, bring about a wider selection in the future purchasing of periodicals. We trust that the most liberal interpretation will be placed upon the phrase "scientific periodicals," and that all departments of knowledge will be equally represented in respect of their research periodicals. On this and other points intending subscribers will no doubt be able to obtain further information, if desired, from the Conjoint Board.

The decision of the Electricity Commissioners on the schemes submitted to them in June and July last for re-organising the electricity supply in the London and Home Counties district was published last week. The Commissioners approve of the establishment of a joint authority on practically the same lines as those suggested by the London County Council, the local authorities owning electricity undertakings, and most of the principal supply companies. It will be remembered that the evolution of the scheme was to be in two stages. In the first stage, which ends at latest in 1926, about twenty-four of the existing generating stations were to be turned into sub-stations, receiving their energy in bulk from the remaining stations, which were to be linked together by interconnecting cables. This proposal receives the sanction of the Commissioners. In the second stage the original proposal was to shut down an additional twenty-six stations, leaving seventeen stations for generating the electrical energy. Two of these were to be capital stations, seven auxiliary stations, and the remaining eight to be kept at work until it became practicable to connect them with the others by transmission mains. The Commissioners, however, do not approve of this proposal. Their investigations show that it is more economical to build another super-power station in 1926 than to go on developing the stations which will then be in existence. To do this will involve less capital expenditure, and will reduce the annual cost of supplying electricity to the authorised distributors from 1·15d. to 0·98d. per unit. The new station will be situated at Barking. Unfortunately, members of the Committee of the Supply Companies are raising objections to this proposal. They desire that the whole of the financial control of the joint authority's work should be in the hands of those members of that body who provide the necessary capital. Seeing, however, that they obtain an extension of their tenure as distributors, it ought not to

be difficult to arrive at a compromise. The Commissioners anticipate that no political difficulties will arise to prevent this pooling of engineering resources. The prospects of real progress being at last made are therefore favourable.

THE first of the Christmas course of juvenile lectures at the Royal Institution on Electric Waves and Wireless Telephony by Prof. J. A. Fleming will be delivered next Thursday, December 29, at 3 o'clock, on "Surface Waves on Liquids." The succeeding lectures will deal with "Waves in Air," "The Telephone," "Electric Oscillations," "Electric Waves," and "Wireless Telephony."

THE extraordinary distances at which radio messages can be received is well illustrated by the fact that, except when atmospheric conditions are unusually bad, the messages sent from the Post Office station at Leafield are received at Perth, Western Australia. For instance, a news message of 448 words sent from Leafield on December 4 was heard at Perth, and was at once communicated to the Australian papers for publication. The Leafield station is the first station of the Imperial radio chain which is as yet only in course of erection.

As is well known, university professors and their families in Vienna are in dire distress. Amongst these is Prof. Tschermak, who may justly claim to be one of the most distinguished of living mineralogists. He is eighty-five years of age, and has a wife and daughter dependent on him. His pension, though large in kronen, is now equivalent to a sum of between 10*s*. and 1*l*. a month. His case appeals especially to members of the Geological and Mineralogical Societies, of which he has long been an honorary member. An endeavour is being made to secure for him during the coming year the means of existence. Prof. W. J. Lewis, University of Cambridge, and Prof. H. L. Bowman, University of Oxford, will gladly forward any sums sent in aid.

THE French Chamber has voted a sum of 50,000 francs for the purchase of the small house and garden at Sérignan, where for many years Jean Henri Fabre prosecuted his study of the habits of insects. Fabre died in the autumn of 1915 at the age of ninety-two. He had been a teacher at Ajaccio and Avignon before he retired, first to a little desert corner near Orange, on the Lower Rhône, and then to Sérignan, in the Department of Vaucluse. As an observer of insects he has been placed second only to Réaumur. He was made a Chevalier of the Legion of Honour and a corresponding member of the Institute, and his house has been a place of pilgrimage for many admirers of his writings. His heirs have consented to the house becoming national property, and his eldest daughter will fulfil the duty of guardian.

WE are glad to learn that Essex farmers have shown their appreciation of the valuable work of Prof. R. H. Biffen, professor of agricultural botany in Cambridge University, and of Mr. E. S. Beaven, of Warminster, in introducing Little Joss and Yeoman wheats and Plumage Archer barley respectively, by presenting two silver bowls to them. It may be remembered that the Darwin medal of the Royal Society was awarded last year to Prof. Biffen for his work on the inheritance of characters in wheat and barley. His new wheats—Little Joss, which owes its value to its immunity from yellow rust, and Yeoman, which combines high yield with first-class baking quality—are among the most popular wheats in England, and together account for practically one-half of the country's wheat crop.

IN reply to a question in the House of Commons, the Home Secretary stated on December 15 that as the result of a conference held with representatives of the French and Belgian Governments, an agreement was reached that the summer-time period should commence on the night of the last Saturday in March, or the last Saturday but one in March when the last Saturday is the day preceding Easter Day, and end on the night of the first Saturday in October. In view of the serious inconvenience at present caused by the difference between the three countries in the dates of commencing and ending summer-time the Government has approved the proposal, which corresponds very nearly to the dates which have been fixed in this country. It is intended early next session to introduce a Bill to give effect to this proposal.

THE suggestion has been made that part of the German reparation indemnity should be paid by the construction in this country of electric generating stations and the carrying out of railway electrification by German contractors. The council of the Institution of Electrical Engineers in a letter to the Prime Minister states its objections to the proposal. It points out that if German plant is to stand as a contribution towards reparations its value must be paid for by the undertakings using it. There is no reason, therefore, to suppose that users would get a cheaper service than with new equipment of British manufacture. Moreover, it would certainly largely increase unemployment in several of the electrical manufacturing industries. Any possible immediate advantage could not offset the possible ruin of the manufacturers of steam turbine plant and heavy electrical machinery, both of which had their sole origin in British science and inventiveness.

THE third International Congress of the History of Medicine will be held in London under the presidency of Sir Norman Moore on July 17–22 next. Meetings will be held at the Royal Society of Medicine, the Royal College of Physicians, the Royal College of Surgeons, and the Welcome Historical Museum, where there will be an exhibition of objects connected with the history of medicine, surgery, and the allied sciences, including ancient manuscripts, early printed books, etc. The subjects suggested for discussion are as follows:—(1) The principal seats of epidemic and endemic disease in the Middle Ages, including plague, gangrenous ergotism, leprosy, and malaria, and (2) the history of anatomy. Further information may be obtained from the general secretary, Dr. J. D. Rolleston, 21 Alexandra Mansions, King's Road, London, S.W.3.

ATTENTION was recently directed to the importance of mapping from the air, especially in the preliminary survey of routes for new railways and roads, approaches to possible harbours and prospecting of all kinds. Prof. B. M. Jones gave in the *Times* of December 13 some indication of the kind of experimental work in this subject which is being pursued at Cambridge under his direction, with the co-operation of the department of geography in the University and the financial assistance of the Department of Scientific and Industrial Research. For aerial photography to be of value for accurate survey it is essential to know the angular position of the camera when the photographs are taken. While it is possible to calculate the tilt from the position on the plates of known ground-marks which have been independently surveyed, a more satisfactory solution of the problem is to improve the flying until the camera varies from the correct position only within a certain permissible angle. Experimental work at Cambridge has been mainly in this direction, but has also touched the further problem of flying so as to cover the ground without gaps or excessive overlapping between the strips of photographs.

AT the annual general meeting of the Faraday Society held on December 13 the following officers and council were elected for the forthcoming year:—*President:* Prof. A. W. Porter. *Past-Presidents:* Mr. J. Swinburne, Sir R. T. Glazebrook, and Sir Robert Hadfield. *Vice-Presidents:* Mr. W. R. Cooper, Prof. C. H. Desch, Prof. F. G. Donnan, Dr. J. A. Harker, Mr. E. Hatschek, Prof. T. M. Lowry, and Dr. G. Senter. *Treasurer:* Mr. R. L. Mond. *Council:* Prof. A. J. Allmand, Dr. H. Borns, Mr. Cosmo Johns, Prof. W. C. McC. Lewis, Prof. J. R. Partington, Mr. C. C. Paterson, Dr. J. N. Pring, Prof. A. O. Rankine, Dr. E. K. Rideal, and Sir Robert Robertson. In the annual report it was stated that during the past year four general discussions had been held, three of them in co-operation with other societies. Reports of the proceedings of these discussions had been published. An appeal was made for an increased membership, without which it would be difficult for the society to keep pace with its increasing activities without a higher subscription.

THE following fellowships for medical research each of the annual value of 400*l.* have been awarded by the Trustees of the Beit Memorial Fund. The proposed subject of research and place at which the work will be carried on are indicated for each fellow:—Mr. R. K. Cannan: Studies in some chemical aspects of metabolism and digestion, at the Institute of Physiology, University College, London. Mr. H. D. Kay: The degradation of carbohydrates and allied substances by micro-organisms, at the Lister Institute, Chelsea. Miss Mary K. F. Lander: Examination of optic regions in primate brains, clinical observations, and physiological experiments with the view of ascertaining the crucial stages of the evolutionary process of development of stereoscopic vision and conjugate movements of the eye, at Department of Human Anatomy, University College, London. Dr. H. Goldblatt: The quantitative relation of fat-soluble A deficiency to the development of rickets (experimental rickets); the effect of parathyroidectomy on immunity, with special reference to its effect on the natural resistance of the rat to tuberculous infection, at the Lister Institute, Chelsea. Dr. L. Gross: Microscopic and macroscopic investigation and experimentation in the condition known as "intestinal stasis," at the Royal College of Surgeons and the Zoological Gardens, Regent's Park. Dr. Ethel M. Luce: Accessory food factors, with special reference to the relationship of ductless glands to calcium metabolism, at the Lister Institute, Chelsea.

THE *Review of Applied Entomology*, which is devoted to abstracts of the literature of that subject, unlike many other publications, has not had to curtail its pages owing to financial stringency. An index to the literature of agricultural entomology which has been abstracted in vol. 8 has lately been issued, and occupies nearly 200 pages printed in double columns. The size of the index indicates the vast amount of literature that is dealt with in the course of a year by the experts on the working staff of the Imperial Bureau of Entomology.

THE curator of the Hull museums is active in making known all accessions and other features of interest by small pamphlets, frequently reprinted from his own articles in the local newspapers, and sold at twopence each. In 1908, as publication No. 48, he issued an index to the previous forty-seven publications, and now, as No. 96, he sends us the index to Nos. 49–95. By this time, however, the serial number has mounted to 123, which last is a descriptive catalogue of exhibits temporarily arranged at the Wilberforce Museum in celebration of Andrew Marvell's tercentenary. Another of these most useful indexes may, therefore, be expected before long.

AN important new map of the Tibesti, Borku, Erdi, and Ennedi regions in the heart of the Sahara is published in *La Géographie* (vol. 36, No. 3). The map, which is on a scale of 1 : 2,000,000, is the outcome of Col. J. Tilho's work in that region between 1912 and 1917. Previous cartographic material was of a scanty nature, consisting, as it did, of rough itineraries, of which Nachtigal's seems to have been the most important, although it did little more than touch the western edge of the Tibesti region. No preliminary material included any astronomical positions. Col. Tilho's survey was based on Faya, the position of which was determined with great accuracy.

THE report for the year 1920 of the museums of the Brooklyn Institute of Arts and Sciences gives details of Mr. R. C. Murphy's expedition to the Peruvian Littoral. Reports on this work have appeared serially in the *Museum Quarterly* since April, 1920. In June we noticed Mr. Murphy's visit to the guano islands, and we now find in the April number of the *Museum Quarterly* an interesting account of Independencia Bay, which harbours giant crabs, huge mussels, and other big things, including, on occasion, the British Pacific fleet. A number of motion pic-

tures were taken by Mr. Murphy, and his collections are said to comprise practically the entire terrestrial life of the Peruvian islands, together with geological samples, a series of sea fishes, and invertebrates collected during tow-net hauls in the Humboldt current.

UNDER the title of "Notes Relating to the Aboriginal Tribes of the Eastern Province" Mr. I. Hewitt, in the *South African Journal of Science* for 1920, discusses some relics of a pre-Bushman race. We have, in the first place, stone implements which are supposed to be analogous to those of the period of Neanderthal man in Europe, though the question of the age of the gravels in which they are found has not been determined with certainty. Next come the remains in the coastal districts, consisting of extensive shell-mounds which are ascribed to the so-called Strandloopers, who fed on shell-fish and other marine products. In the course of this scholarly paper Mr. Hewitt collects the historical data regarding the Hottentots and Bushmen. From the craniological evidence the coast population seems to have consisted of bastard tribes containing Bushmen, Hottentot, and Kaffir elements. One skull appears to resemble the "Proto-Egyptian" type described by Prof. Elliot Smith. This is, if true, significant, because some authorities have suggested on linguistic grounds a relationship between the Hottentots and various northern pastoral tribes, one of which, the Gallas, makes use of clicks. At present the evidence in support of this theory is scanty, but further investigations in South Africa may lead to the settlement of an interesting problem.

THE annual part of the Transactions of the Norfolk and Norwich Naturalists' Society (vol. 11, pt. 2, 1921) reflects in excellent manner the activities of this admirable local society. Mr. B. B. Riviere, the president, leads off with a wealth of new observations towards the solution of the hitherto rather mysterious phenomenon of the daily autumnal migrations of gulls on the Norfolk coast. The account is full of interest and deserves wide publicity. Other bird papers include an attractive account by Mrs. Watson of the methods used in the taking of a census of eggs of the common tern on Blakeney Point, together with notes on the nesting habits of these birds, and a short authoritative statement by Dr. Sydney Long, the secretary of the society, of what is being done towards reorganising, correlating, and extending the measures for bird protection in the county. On the botanical side Mr. W. G. Clarke and Mr. Robert Gurney contribute a valuable study of the biology and distribution of the bladderwort (Utricularia), whilst Mr. Clarke, in another article, revisits the botanical localities (for Norfolk) mentioned in Dawson Turner's "Botanists' Guide through England and Wales" (1805). The part closes with notes of local interest and with obituary notices. The number is in all respects a valuable one.

THE researches of Prof. Hamburger, of Groningen, on the permeability of cells have been of continuous interest in their various developments since he investigated the laking of red corpuscles in dilute salt solutions more than thirty years ago. A convenient summary and survey of the whole was given by him in a lecture delivered at the University of London in June last which appears in the *Lancet* of November 19. That cells absorb some things from solutions and fail to take up other substances is a well-recognised fact. This has been attributed to a differential selective activity on the part of the living cell, closely correlated with its physiological needs, the precise psychological attitude of the cell varying with the particular sort of neo-vitalism which advocates it. Prof. Hamburger, on the other hand, premises a purely physico-chemical problem, and urges with considerable cogency that the intricacy and efficiency of these processes is commonly under-estimated. He shows, for example, how permeability may be altered by changes in the conditions and environment; carbon dioxide profoundly modifies the permeability of red-blood corpuscles and the permeability of the kidney glomeri to sugar is entirely changed by alterations in reaction of the liquid in which the sugar is dissolved. Emulsions, with which he thinks the boundaries of cells may fairly be compared, contain liquid pores which vary in shape and size according to the exact composition and concentration of the reacting substances, and he frankly attributes to their varying configuration some of the apparently anomalous instances of "selective" permeability.

THE Ministry of Agriculture has just published in collected form its leaflets dealing with the cultivation and diseases of the potato, the insect pests of fruit trees, and the fungus pests of fruit trees, and these three sectional volumes make a very welcome addition to the literature on diseases of plants in this country. The text of the leaflets has all been rewritten and brought up to date, thus representing the most modern outlook on the subjects considered, and each little volume opens with a very happy introductory chapter. In fact, each book is a partial monograph on the specific host plants, and combines in a somewhat rare manner a summary of the latest scientific investigations on the particular diseases and some very practical measures of prevention and control. The letterpress is good, and the illustrations in many cases noteworthy. These little books are indispensable to practical growers, and should be in the possession of all students of agricultural colleges or agricultural and botanical schools of universities; they really form the nucleus of what might with a little energy be expanded into a standard text-book on English plant diseases. A very great deal of credit is due to Messrs. Cotton and Fryer, who have compiled these volumes, and to the Plant Pests and Publications Branches of the Ministry of Agriculture for having had sufficient imagination to publish them in so attractive and convenient a form. It only remains to add that the price of two of the volumes is eightpence each, and of the third tenpence, and they are probably the best value in biological literature to be had for the money.

THE law of the geoidal slope and fallacies in dynamic meteorology is the subject of an article in the *Monthly Weather Review* for October, 1920, by

Dr. C. F. Marvin, chief of the U.S. Weather Bureau. Referring to the action of gravity upon bodies moving over a rotating globe, it is said to be expressed in two wholly independent inertia reactions; one, the law of equal areas, is stated by the author to have been fully recognised; the other action, though known, is said never to have been christened, and its important part in controlling the motions of the air is said to have been overlooked and misunderstood. Dr. Marvin names this neglected principle the law of the geoidal slope. Detailed quotations are given from popular and mathematical writers, and their errors are pointed out. The article concludes with a number of categorical statements, giving important principles which the motions of the atmosphere must satisfy. This paper by Dr. Marvin formed the subject of the discussion at the Meteorological Office at the first lecture-meeting of this season, which was opened by Sir Napier Shaw. A notice of the meeting at the Meteorological Office and of the discussion on Dr. Marvin's paper is given in the *Meteorological Magazine* for November, and after a little criticism it sums up with the following remark: "Although the points brought out by Prof. Marvin are familiar to most workers on dynamic meteorology, the publication of the paper should call attention to the weak spot in many text-books, and so improve the standard of teaching the subject."

WHEN an electric current passes through a long tube containing gas at a low pressure, one of the most striking effects is the alternation of intensity of light in the column of gas in contact with the positive electrode. The reasons for the alternations of electric field on which the alternations of light depend were stated in a general way by Sir J. J. Thomson in his "Discharge of Electricity through Gases," but in the December issue of the *Philosophical Magazine* he gives these reasons a more definite and precise form. By assuming that the current in the tube is carried entirely by the electrons, he reduces the mathematical difficulties considerably, and arrives at the conclusion that when the pressure is less than a certain minimum determined by the nature of the gas there will be at the end of the column nearest the cathode periodic variations in the luminosity, which will decrease in magnitude as the positive electrode is approached, and that these variations will be superposed on a continuous luminosity. These conclusions are in agreement with observation

WHEN running small electric motors it is necessary, as a rule, to have resistances in the circuit at the start which can be cut out when the speed of the motor is sufficiently high. Bare resistance wires are often used for this purpose, but as a rule they soon become very brittle, and so have periodically to be replaced. We recently had an opportunity of testing two zenite resistances manufactured by the Zenith Manufacturing Co., of Willesden Green. They consist of wires embedded in vitreous enamel. One of them carried the rated current successfully for several hours, but the other cracked slightly, the wire becoming exposed The makers state that the thermal coefficients of expansion of the wire of the porcelain, and of the enamel in which it is embedded, are the same. As a rule, however, the temperatures of the three substances will not be the same, and therefore there will be a tendency to crack. The zenite units should prove very useful in a laboratory, as they can be used for regulating the voltage applied to a consuming device in an electric circuit.

VOL. 14 of Contributions from the Jefferson Physical Laboratory and the Cruft Electrical Laboratory of Harvard University is a reprint of twenty-eight papers issued from the laboratories during the years 1919 and 1920. They cover a wide field, and include twelve on X-rays by Prof. W. Daune and his pupils, seven on spectra (two of which are from Prof. Lyman), and six on apparatus for high pressure and the properties of materials at such pressures by Prof. Bridgman. Of the latter one of the most important is that on the effect of pressure on the electrical resistivity of metals both in the solid and liquid states, from which it appears that the change of resistivity of a metal on melting follows the change of volume. The rate of increase of resistivity with temperature is generally less for the liquid than for the solid, and normally the resistivity of solid and liquid decreases as the pressure increases. Prof. Bridgman concludes from his work that the amplitude of the atomic oscillation is the principal factor in determining these changes of resistivity, and he puts forward a new theory of electrical conductivity in metals according to which the electrons of the older theories are not turned back by impact with the atoms, but pass through the latter freely. He shows that this theory reproduces the experimental facts much better than any theory previously advocated.

IN *La Nature* of November 12 M. Lémonon continues, and concludes, his articles on tidal power. The present article illustrates and describes a number of suggested methods of developing power by the use of one or more tidal basins filled at high tide and discharging through hydraulic turbines during the falling tide. Such an installation developing 70 h.p. for about five hours each day, situated at Saint-Jouard-des-Guerets, on the Rance, is illustrated. The use of single- and double-basin systems is discussed, and the barrage arrangements in a number of suggested schemes are dealt with in some detail. The article is purely descriptive, and does not attempt to deal with the efficiency of the various methods outlined or with the financial and economic side of tidal-power development.

THE National Research Council of the United States has issued as its fourteenth bulletin a "General Survey of the Present Status of the Atomic Structure Problem," by Profs. D. L. Webster and L. Page. The former author has contributed a general account of the phenomena, illustrated by diagrams, whilst the latter has given the principal equations which Bohr, Sommerfeld, and others have used in exploring the problem of atomic dynamics. This survey will be welcomed by readers who have not the time or

the opportunity to read the original papers, and perhaps more especially by chemists who are intimately concerned with the results of such investigations, but may not have been trained to the point of being able to follow in detail the methods by which the results are reached.

A NEW method of automatic electric welding was described to the Institution of Electrical Engineers on December 1 by L. J. Steele and H. Martin. Welding by means of an electric arc has long been practised by electrical engineers, but it has drawbacks since the mechanical strength of the weld is sometimes unsatisfactory. As the result of a lengthy experimental research the authors find that when the following sequence of operations is carried out the weld is always successful. In fixing a brass stud to a steel bulkhead, for instance, an arc is first struck automatically between the stud and the bulkhead. The stud is then moved in the direction of the arc until it makes firm contact with the steel. The current is then broken after a brief interval. The whole operation is done automatically, and perfect welds have been obtained between brass or manganese-bronze studs and steel, iron, or brass plates. The method solves the problem of electrically welding metals of widely differing character and very different cross sections. It is of particular value in ship construction, since it does not weaken the bulkheads or make them less watertight. It will be of value, also, in bonding rails together for electric traction.

PART 2 of Messrs. Wheldon and Wesley's Botanical Catalogue (New Series, No. 3), has just been issued. It contains nearly 6000 titles, classified as follows: early botany; Linnæus; botanical journals and transactions; botanic gardens; history, classification, nomenclature, biography, etc.; structural botany and text-books; phanerogams; fossil botany; flora of British islands; local British floras; flora of Europe; flora of Asia; flora of Africa; flora of America; flora of Australasia; diatomaceæ, desmidiaceæ, etc.; marine algæ; fungi; lichens; musci et hepaticæ; filices. It should certainly be seen by all who are on the look-out for books and journals dealing with botany. Copies of the catalogue are obtainable upon application to the publishers, 38 Great Queen Street, W.C.2.

THE latest catalogue of Mr. F. Edwards, 83 High Street, Marylebone, W.1, is No. 421, dealing with books on anthropology, folk-lore, and archæology, including the early history of man, native races, manners, customs, and beliefs, mythology, folk-lore tales, magic, and witchcraft. Upwards of 1100 works are listed.

MR. FREDK. J. BRODIE writes to point out that in the article on "Science in Westminster Abbey," which appeared in NATURE of December 1, p. 437, Dr. William Spottiswoode, who died in 1883 while president of the Royal Society, was incorrectly referred to as "Sir" William Spottiswoode.

Our Astronomical Column.

THE MARKINGS ON JUPITER.—The planet Jupiter will rise on December 25 at 1.14 a.m., and will be visible thereafter until sunrise. It will be due south at an altitude of 33° at 6.50 a.m., and is now favourably visible for the study of its surface features.

Mr. W. F. Denning writes:—"Some interesting observations have recently been obtained by Mr. Frank Sargent, astronomer at the University Observatory, Durham. On December 9 the South Temperate Disturbance, which consists of a dark irregular mass of material and has remained visible for twenty years, was well seen, and its following end came to the central meridian at 17h. 46m. G.M.T., so that its equivalent longitude was 143° (System II.). On December 12 the preceding end of the same marking was estimated central at 21h. 5m. G.M.T., longitude 354°.

"The length of the object was therefore 149°. Its rotation period, when compared with an observation on June 23 last, was 9h. 55m. 30s. On December 12 the red spot hollow was also observed, and its centre was remarked in transit at 18h. 31m. (longitude 260·9°). This value, combined with one derived by Mr. Sargent on May 24 last, shows the intervening rotation period to have been 9h. 55m. 37·8s. The latter marking has been visible for more than ninety years, for Schwabe at Dessau observed, and made a drawing of, the same feature so long ago as September 5, 1831.

"This hollow or basin in the great southern equatorial belt of Jupiter has undergone many changes since its first discovery, and it has been one of the most conspicuous features on the planet, as well as one of the most frequently observed, for it borders the northern side of the great red spot which became a striking object on the planet in 1873."

THE ULTRA-VIOLET SPECTRUM OF α CYGNI.—The resemblance between the spectra of novæ about the time of maximum luminosity and the spectrum of α Cygni has been very generally recognised, the spectrum of Nova Cygni III, taken at the Norman Lockyer Observatory last year, having proved this conclusively. The star α Cygni is one which is increasing its temperature, and is termed a Giant; in fact, it is of great importance in the domain of stellar evolution because there are few stars in the heavens which it resembles. For many years its spectrum was considered very peculiar, no one being able to state the origins of most of the lines. It was, however, solved at last, and, as Mr. W. H. Wright writes, "it required the genius of Lockyer to recognise the stellar lines as belonging to groups of metallic radiations which are stronger in the spark than in the arc." Up to the present time its spectrum has been closely studied in the region ordinarily recorded on stellar spectrograms, namely, from K to Hβ, but the ultra-violet section has taken second place. Any investigation which restricts itself specially to this ultra-violet region is therefore very important, especially if there exist spectra of novæ for comparison taken in this region. Mr. W. H. Wright (Lick Observatory Bulletin No. 332) now fills up this gap by making a detailed examination of this region in the spectrum of α Cygni, and publishing a set of wave-lengths extending from Hδ (λ 4102·0) to λ 3245. Further, he compares these values with some records of the ultra-violet spectra of some of the brighter novæ taken at the Lick Observatory. The result of his comparison is to show that the resemblance between novæ near maximum and the spectrum of α Cygni "is found to be even more striking in the ultra-violet than in the violet and blue regions."

The Origin of the Scottish People.

ON September 9, in the course of the meeting of the British Association at Edinburgh, a discussion on the origin of the Scottish people was held in a joint session of Sections E (Geography) and H (Anthropology), Lord Abercromby, president of Section H, being in the chair. The discussion was opened by theses maintained by Sir Arthur Keith and Prof. T. H. Bryce.

Sir Arthur Keith said that the inhabitants of the Highlands and western parts of Scotland and the inhabitants of the inland parts of Scandinavia were branches of the same racial (Nordic) stock. Seventy years ago Anders Retzius in Sweden and Sir Daniel Wilson in Scotland maintained that the Highland or Celtic Scot and the central Scandinavian showed the same type of head and the same form of body. A comparison of the results of more recent investigations carried on in Scotland and in Sweden and Norway made it certain that Scot and Scandinavian are traceable to a common source. Prof. Carl Fürst, of Lund, maintains that the inland inhabitants of Scandinavia are the descendants of the people who settled in Norway and Sweden on the retreat of the last ice-sheet. All the evidence favours the opinion that the modern Highlander is the lineal descendant of the people who reached Scotland at a corresponding period.

Scandinavian geologists estimate the beginning of the emergence of Scandinavia and Scotland from ice to a period of about 11,000 B.C. The North Sea was then an estuary or bay open to the north, with a western shore leading up to Scotland and an eastern leading to Scandinavia. On the Danish, as also on the Scottish, coasts are found the shell heaps of the "harpoon" folk—the earliest inhabitants of the north-western outskirts of Europe in post-Glacial times. The culture of this people is to be traced to countries in the south-west of Europe, and, although their remains have not been found, we may safely infer that they arose from the long- and big-headed type of man found in South England and on the Continent at the close of the Ice age. It was thus maintained that Scot and Scandinavian were descendants of the late Palæolithic men of South-West Europe.

The accepted opinion that the late Palæolithic races of South Europe had dark hair, eyes, and complexions is probably well founded. Fair hair, light eyes, and clear complexions, which find their fullest expression in the inhabitants of Baltic lands, are best regarded as characters recently evolved. The darker hair and eyes of the modern Scot, as compared with his Scandinavian cousin, may not be due to a later Mediterranean admixture, but to his retaining to a greater degree the complexion of his Palæolithic ancestor. The evidence gathered in all countries round the North Sea points to an increase in stature amounting to 3 in. or 4 in. since Neolithic times, showing that evolution as well as admixture had been at work.

If we suppose that the northward drift of the "harpoon" people took place at the beginning of the Neolithic period—some 6000 or 7000 B.C.—we have to leave about 4000 or 5000 years as a blank in the history of the Scottish people, for it is not until the beginning of the second millennium B.C. that we have trustworthy facts to guide us. At the beginning of this period we find Scotland in free communication with Europe by two portals. Through her eastern coasts she was open to the opposite shorelands of the North Sea and to Central Europe. Graves of this period contain the remains of a peculiar and round-headed people. Lord Abercromby has traced the designs of their pottery to the upper reaches of the Rhine. To this day the effects of the round-headed invasion can be traced in the population of the eastern counties of Scotland and of the coast-lands of Norway and Sweden.

It is quite feasible that the Celtic and Teutonic tongues may be modifications of the speech which reached western Europe in the mouths of the round-head Neolithic invaders. At the same time the pulse of south-western Europe—of the Mediterranean—was beating on Scotland at the western or back door, along what may be called the Celtic sea-passage—St. George's Channel, the Irish Sea, the western shores, to Orkney and to Norway. By this route Ireland and Wales received new settlers from south-western countries of Europe, but did they reach Scotland? Prof. Bryce is of opinion that the people buried in the western megalithic tombs of Scotland represent invaders of the Mediterranean type. They may equally well be considered as the native Nordic people of Scotland; indeed, in such skulls as retain the face there are certain features which suggest a northern origin.

There is no definite evidence of any great invasion of Scotland from the second millennium to the arrival of the Romans. The Roman invasion left no appreciable mark on the Scottish people. But in the fifth century, when the Romans were gone, both eastern and western doorways became again open and busy with visitors. The Dalriad Scots from the north of Ireland entered by the western portal; they may have brought a tongue which was new to Scotland, but they brought no new physical type. From the fifth century onwards, for a period of 500 years, Scotland received at her eastern doorway settlers from the coast-lands on the opposite side of the North Sea. They came from lands which, like Scotland, were first settled by the "harpoon" people. They brought Teutonic dialects to Scotland, other manners, traditions, and arts, but no physical type of manhood which was new to Scotland.

Who were the Picts? The people of Aberdeenshire were Picts in the ninth century; there is no reason to question that the bulk of the present population of that county are their children. An Aberdeenshire man cannot be recognised from another native of Scotland except by his speech. The Picts, Celts, and Saxons of Scotland are all of one breed—the descendants of the pioneer race which settled in North-West Europe when the last ice-sheet lifted. There has been only one intrusive element—the round-head of late Neolithic introduction.

Prof. T. H. Bryce said we now know that Scotland was inhabited as far back as Azilian times. We have no direct evidence regarding the physical characters of these early inhabitants, but there is a strong presumption that the primitive basis of the population was Nordic in character. Superimposed on this came, first, in late Neolithic times, the men of the chambered cairns, and second, the Beaker folk of the Bronze age. These three elements, blended in different proportions, made up the population of pre-Roman times, since when it has been altered only by the intrusion of similar elements and reassemblage. In South-East Scotland there are traces of a new element in the Iron age with a late La Tène culture. It resembles the Gaulish, but the interments are native, not Gaulish. The distribution of the chambered cairns and burials of the Bronze age indicate a grouping of the elements which, taken in conjunc

tion with the movements of historical times, explains the well-known features of the present-day population.

In declaring the subject open for discussion the president, Lord Abercromby, referred to the high percentage of broad-headedness found in the Island of Borreby, and expressed a doubt as to whether, at any rate in very early times, immigrants into these islands had used the direct route across the North Sea.

Dr. J. F. Tocher dealt mainly with the modern inhabitants of Scotland. In the course of his investigations of the physical character of the Scottish people he had made observations on some 13,000 individuals in all, the data obtained including head measurement, stature, and pigmentation. He had found the average stature to be 67½ in. The cephalic index showed wide variation, the inhabitants of the north-east being broad-headed and of the south-west long-headed. In absolute size the Aberdeen head was less than that of the rest of Scotland. In the north-east there was a significantly greater proportion of red hair. Speaking generally, he deprecated any conclusion as to the origin of the Scottish people based upon physical character on the ground of the relative paucity of the data.

Prof. R. W. Reid said that as a result of a number of observations made upon the inhabitants of North-East Moray, it appeared that the average stature was 5 ft. 7½ in., while the head form was mesaticephalic, approaching broad. They were almost identical with the young men of Norway. An examination of skeletal remains of the short cist people, approximately from the same tract of country, gave a stature of 5 ft. 4 in., with a cephalic index of 85. It might be agreed that a combination of long and broad heads afforded a clue to the physical characters of the people of this part of Scotland.

Prof. Jehu said that man existed in Scotland at the time of the formation of the 45-ft. raised beach, for which the accepted date was 10,000 years ago, while in southern England Neolithic implements had been found in the submerged forest. When man entered Scotland the Highland valleys were filled with ice. Owing to lack of evidence, it was dangerous to speak of the physical characters of the "harpoon" folk. There were no data to show they came from Scandinavia. The Scottish people were a very mixed race, and more evidence was needed before any conclusion was drawn as to their origin.

In a communication from Prof. W. S. Watson, who was unable to attend on account of illness, it was argued that, although language was no criterion of race, it afforded evidence of influence, political, cultural, or economic. It was possible to trace the Celtic language in Scotland with certainty back to the fourth century B.C. The chiefs are described as uniformly fair-haired with blue eyes, like the rulers of Gaul in Cæsar's time, and as it by no means follows that all the population was of one type, they probably ruled over a dark-eyed subject people. Among non-tribal names preserved in early writings there were elements which well might be pre-Celtic.

Mr. H. J. E. Peake took exception to the loose use of the term "Nordic," which should be confined to the tall, fair-complexioned, blue- or grey-eyed people, whose chief characteristics were strength, courage, activity, and an intense admiration for the horse. Such a people were not likely to be descended from a sedentary, maritime race such as the "harpoon" folk, but must have been derived from a race which had evolved in the open spaces necessary for the taming and exercising of the horse. The Scottish people had evolved from a generalised type of long-headed people, but there was no true Nordic type until the end of the Bronze age. The leaf-shaped sword people had arrived on the east coast of Scotland about 1200 to 1000 B.C., and were in all probability the fair rulers to whom reference had been made. He had already suggested a possible Siberian origin for the "harpoon" or Maglemose folk, and had also suggested that they were responsible for the broad, possibly, Mongoloid, element occurring among Scandinavian skulls. Still, they might be derived from a Palæolithic race in south-western Europe.

Prof. Fleure urged the desirability of a careful search, especially in the remoter parts of Scotland, for nests of survivals of Palæolithic types such as he had found in Wales.

Mr. D. Mackenzie pointed out the necessity for distinguishing between the Maglemose and Azilian harpoons, the former being of bone, while the latter were of horn.

An Agricultural Enterprise.

AN interesting and important development is recorded in the report under notice.[1] The Olympia Agricultural Co., Ltd., is a comparatively recent enterprise which is farming nearly 10,000 acres of land on strictly business principles, one of the first examples of the application of industrial methods to the exploitation of land in this country. The company's land lies in six estates, and, in addition, the Suffolk estate of the chairman of the company, Mr. Joseph Watson, amounting to some 7000 acres, is linked up with the operations of the research department. It is not possible here to discuss the actual operations of the company in equipping its estates, the additions to and reconstructions of the buildings in order to fit them for large-scale farming, the provision of cottages, water-supply, etc., nor, again, the stocking and management of the farms. From this purely commercial side it is evident that an experiment is being made of extraordinary value in handling English land in a wholesale instead of a retail fashion and in providing for agriculture an organisation and an equipment comparable to that appertaining to any other great industry. It has often been thought that in such a way only can intensive production and adequate labour conditions be ensured in agriculture, and the enterprise therefore becomes one of the utmost importance in our social and national economy.

The aspect of the enterprise that will, however, be of the most interest to the readers of NATURE is that the directors have from the outset been convinced of the necessity of scientific investigation in the conduct of their business. They have, therefore, set up a research department, just as a steel works includes a laboratory, and they have, further, been public-spirited enough to give to the public for the general benefit of agriculture the results of their investigations in this first annual report. The headquarters of the research department have been established on one of the company's estates at Offchurch, near Leamington, where in the old mansion a very complete equipment of laboratories, both biological and chemical, has been installed. Dr. Charles Crowther, formerly

[1] Olympia Agricultural Co., Ltd. Research Department. First Annual Report, 1921.

of the University of Leeds, and well known for his work upon the nutrition of animals and milk production, is director of the establishment, and takes charge of the work upon animal-feeding; Capt. Hunter, late of the Department of Agriculture in Ireland, is responsible for the plant-breeding work; and Capt. Gimingham, who was attached to the Research Institute at the University of Bristol, is concerned with soil problems. These heads of divisions, with twelve others, constitute the research staff.

The work set out in the report before us is necessarily of a preliminary character. The first business of a scientific establishment of this kind is to supply data for the guidance of the management. The varying soils of the estates have to be analysed and correlated with the results of manurial trials in order that the specific needs of each field as regards lime and the main elements of fertility can be defined. Variety trials of the principal crops have to be made so as to ascertain what kinds of grain and fodder crops yield best under the several conditions of soil and climate. Again, economic feeding rations have to be worked out by trial for the particular classes of livestock and the special purposes for which they are being kept. All this is not research, but the scientific control necessary to a business organisation.

Most of the present report is occupied in setting out such results, which may usefully be correlated with similar commercial trials, but do not present any essential novelty. Research is an affair of years, and wisely the director makes no promises and says nothing about the real investigations he may have initiated. It is clear, however, that new ground is being broken, particularly in connection with plant-breeding. The field bean, for example, has been taken in hand; on many soils it is a crop of considerable economic importance, which never seems to have received any serious attention from the seedsmen or the older race of plant-improvers.

The report may be obtained on application to the director at the Research Station, The Bury, Offchurch, Leamington. It is the first fruits of a movement of great promise to agriculture, and redounds to the credit of both the director and the founder of the company, Mr. Joseph Watson.

Optical Wedges.

WEDGES of tinted glass have been used for graduating light for experimental purposes during the last fifty years or so, and about five and twenty years ago Warnerke made annular wedges of pigmented gelatine. It is twenty years since the "Chapman Jones plate tester" was put on the market, the graduated portion of which is a pigmented gelatine wedge, the mould being cut into five pieces that are placed side by side for the sake of convenience. Optical wedges, therefore, have been well established as standard apparatus for a long time.

We have received from the firm of "Herlango," of Vienna (at the request of Prof. J. M. Eder) an example of "a new grey wedge photometer," called, after the names of those who have devised it, the "Eder-Hecht" photometer, the essential part of which is a pigmented gelatine wedge with a scale printed on the thin celluloid that covers its face. This, with a neatly made white wood printing frame, is the complete apparatus. The plate is 3 cm. by 16 cm., and the divisions of the scale are 2 mm. apart. But the scale is not a simple ladder. Every fifth line is numbered with its mm. distance from zero, and, in addition to the number, has on each side of it a short thick pointed swelling to emphasise it and render it more easy to see how far the light-produced image extends. For use with it the firm issues various sensitive papers, both printing out and development, a silver-chloride paper made according to the formula of Bunsen and Roscoe, and also a colour-sensitised paper. An extended table gives the relative light quantity, and also the "absolute light quantity in Bunsen-Roscoe units," represented by each 2-mm. division. Thus, given the suitable sensitive paper, the apparatus is ready for use and convenient. It is applicable to light measurement in connection with photography, meteorology, climatology, biology, light-therapeutics, agriculture, the designing of buildings, botany, photographic reproduction processes, etc. Photometers slightly varying from the above, as in steepness of gradation, length of the wedge, the character and coarseness of the printed scale, are provided when more convenient. For photographic plate sensitometry the wedge plate is 9 by 12 cm., and by the side of the ladder scale are four narrow graduated strips, red, yellow, green, and blue respectively.

Accompanying the photometer is a copy of a paper by Walter Hecht on the use of such photometers in plant culture and a copy of a paper by Prof. Eder published in the *Photographischen Korrespondenz* for September, 1919, in which he gives apparently every possible detail and formula in connection with these photometers. But he does a considerable injustice to the Chapman Jones plate tester in associating it with Warnerke's original step-tint sensitometer. It differs from the sensitometer designed by Prof. Eder in having a wedge from two to three times as long and divided into twenty-five parts instead of sixty parts. These twenty-five parts may be subdivided to any extent on mere inspection according to the observer's acuteness of vision. It has the four colours giving four definite parts of the spectrum, and, in addition, an Abney colour sensitometer, which shows at a glance whether a plate alone or a plate *plus* a colour filter gives the same density for equal brightness of several colours. We think, too, that comparing the density produced under any given colour with a scale of densities admits of greater precision than the estimation of the vanishing point of the image as is done in Prof. Eder's instrument. C. J.

The South African Association for the Advancement of Science.

DURBAN MEETING.

THE nineteenth annual meeting of the South African Association for the Advancement of Science was held at Durban, in the Technical College, on July 11–16 last, under the presidency of Prof. J. E. Duerden. The meeting was well attended, and was very successful. More than fifty papers were read, and the time-table was so arranged that attendance at the presidential address of each section was possible for every member. An official welcome and a reception in the Art Gallery was given by the Mayor of Durban, while a conversazione was arranged by the local committee of the association and the Natal

Society for the Advancement of Science and Art. A number of interesting excursions to places of local interest were arranged.

A popular lecture, illustrated by lantern slides, was given by Dr. A. L. du Toit, geologist to the Irrigation Department, on "Land Connections between the other Continents and South Africa in the Past." The lecture dealt with the ancient continent of Gondwanaland, its glaciation, the spread of animal and plant life across it, its dismemberment, the development, geographically and biologically of the several portions, their temporary reunion, and finally the evolution of the present continental masses.

The South Africa medal and grant were presented to Sir F. Spencer Lister, bacteriologist to the South African Institute for Medical Research, Johannesburg, in recognition of his work on the differentiation of the pneumococci of lobar pneumonia into many immunologically distinct groups, and the successful application of the discovery to the artificial production of immunity against pneumonia in man.

The presidential address by Prof. Duerden was on "Social Anthropology in South Africa: Problems of Race and Nationality." A sketch of the rise of social anthropology was given, and the view was maintained that anthropological studies should contribute to the upbuilding of the State by offering a scientific understanding of the peoples within it. Such was very necessary in South Africa, with its very diverse stages of social evolution and its many distinct races and nationalities which should live together in harmony and build up a South African nation. The alleged aversion between white and black was discussed, and was shown to manifest itself only on an assumption of equality, the difference in the degree of civilisation being too great to be bridged. The Bantu is highly assimilative, but neither originative nor constructive, and hence is dependent on the European for his advancement. The fusion of racial groups in South Africa was discussed, and the opinion given that there would be no fusion, though the members would intermingle in ordinary avocations. Solidarity of race may be superseded by national bonds and loyalty under just and humane treatment. The retention of national aspirations of British and Dutch are not incompatible with a South African national solidarity. It was held that a new unifying South African nationalism was dawning, and that the future relationships of the European to the lower races must be that of a benevolent aristocracy of ability.

The presidential address to Section A, by Dr. J. Lunt, of the Royal Observatory, Cape Town, dealt with "Stellar Distances, Magnitudes, and Movements." The speaker reviewed briefly the development of astronomy, the oldest science, and discussed various spectrographic methods, especially in relation to the determination of the distances, sizes, and movements of stars. The work in astronomy in the United States was described at some length, and comparison made with the conditions prevailing in South Africa. The new universities of South Africa should play a part in the development of astronomical and astrophysical research here, where the study of the skies of the southern hemisphere was an essential complement to the work in the northern observatories. The address concluded with a vigorous appeal for the training of workers, for adequate equipment, and for a better appreciation of, and reverence for, the wonderful universe of which man forms so small a part.

Dr. J. Moir, in his presidential address to Section B, dealt with "The Atomic Theory of 1921." He showed the tremendous strides that had been made in the conception of atoms and molecules in the last twenty years. Two primitive materials, hydrion and electron, with two intermediate building substances, H_2 and H_3, as well as helium, are considered to be the basis of all elements. The constitution of a number of elements was explained and illustrated in detail, numerous examples being given. Many cases were cited in which physical means during the world's evolution may have acted on different substances; for example, strontium sulphate, yttrium phosphate, and zirconium silicate, which now have similar electron and ion constitutions, are three very different substances which may really be one, changed by external forces.

Prof. J. W. Bews took as his subject, "Some Aspects of Botany in South Africa and Plant Ecology in Natal," in his presidential address to Section C. The speaker sketched briefly the effect of environment on progress in botany. The history of botany widened the perspective, and it was interesting to note the progress of the science as transplanted into South Africa. The only indigenous botany was that of the natives, who possessed a wonderful knowledge of plants and their properties. Passing to botany in Natal, the speaker paid tribute to a number of pioneer workers, and proceeded to discuss the ecology of Natal more particularly. The coast belt, the midlands, and the Drakensberg or mountain region, were described, with their characteristic vegetations. The plant communities of Natal were discussed in some detail, as were plant migrations and the affinities of the Natal flora.

The presidential address to Section D was delivered by Prof. H. B. Fantham, on "Some Recent Advances in Zoology and their Relation to Present-day Problems." At the outset the field of pure science was discussed. Such must never be ignored, for the academic of to-day may be of the greatest technical benefit hereafter. Early specialisation for purely economic ends was to be deplored, for the specialist needed a breadth of outlook, an orientation in the whole field of his science, in order to have balance and perspective. The work done by protozoologists, helminthologists, and entomologists in the great war was referred to, and fields of work in South Africa indicated. Recent researches on ductless glands of animals were cited, and fisheries developments were noted. Many interesting results in connection with work on chromosomes and their relation with sex were quoted. Newer work in connection with the processes of evolution, especially in regard to heredity and acquired characters, was brought under review. The need for the application of biological principles in modern problems, including politics, was insisted upon. Heredity, environment, and response to stimulation needed concurrent attention. The higher standard of living for workers demanded more than mere amusement and indulgence in luxuries and excitement. Idealism was essential, and it was shown that religion and science were not necessarily in conflict. The speaker concluded with a plea for the inculcation of the spirit of biology in all education. With a widespread knowledge of history, biology, and sociology, man should improve his environment and attain co-operation, peace, and higher ideals.

Section E met under the presidency of Dr. C. T. Loram, who discussed "The Native Problem." The adjustment of white and black was difficult in South Africa, and a successful adjustment was held to be impossible without sacrifices on both sides. The chaotic political situation with regard to natives in the different provinces of South Africa was described. Legal procedures and jury systems were also mentioned, and it was a question whether the Roman-Dutch law of Europeans were best for the native on account of the differences between the two civilisations

concerned. The mentality of the native was analysed, and because of the lack of sublimation of the sex instincts, such as occurred in the European, there was not the same growth in ambition, idealism, and general achievement. The trade union movement among natives and their numerous religious bodies were mentioned, and European philanthropic leading was mentioned as being desirable. Location and taxation problems were discussed, and the co-operation of all scientists desired in solving the many problems connected with the native.

Prof. W. A. Macfadyen spoke on "Observations and Proposals for the Stabilisation of Money Values" in his presidential address to Section F. Inflation and deflation of currency were two of the greatest evils resultant on the great war, and they affected everyone. The stabilisation of money values and the preservation of such stability were shown to be the most fundamental interests of commercial, industrial, and democratic policies. National bankruptcy was defined, and it was shown that international exchanges had failed to act as bridges for commerce. The dissipation of capital during the war led to inflation, and the necessity for constant readjustment between wages and prices led to constant strikes and labour unrest. Legitimate trade and industry were replaced by speculation. Economic bankruptcy of a nation meant reversion to an archaic type of civilisation and the sacrifice for a time of all the artistic and professional values of civilisation. Fluid permeation of gold was shown to be necessary. The function of a central reserve bank was also discussed, and the function of the League of Nations in instituting an international currency reserve bank was indicated. The speaker summarised his points thus: The international export and investment of capital had woven the world into one financial system. Such an international system implied either a universal unit of account or an international banking system. The control of such a general standard of value so as to preserve an invariable ratio between goods and money was the most important of public and private interests.

It is only possible to mention some of the many papers read before the various sections, but most of them will be printed in the journal of the Association.

In Section A an interesting paper on asphalt in relation to road construction was contributed by Mr. D. B. W. Alexander; Mr. R. J. Norris spoke on the purification of sewage by the activated sludge process, and Mr. H. Clark gave notes on the occurrence of even harmonics in electrical current and pressure waves.

In Section B Mr. C. W. Petchell spoke on alcohol fuels for internal combustion engines. Mr. C. Williams gave notes on the chemical control of cattle-dipping tanks, a matter of much importance in South Africa. Dr. B. de C. Marchand gave an account of methods for the mechanical analysis of soils containing heavy minerals, and Messrs. Kloot and Hyman gave a paper on the chemistry of condensed milk.

In Section C papers were given by Miss H. Forbes on the Natal species of Cassia and on the flora of Isipingo. Dr. P. A. van der Bijl gave accounts of some interesting and little-known South African fungi, and of the fungi found in the air of sugar mills. Mr. R. D. Aitken described the plant succession in a type of midland tree veld in Natal, and Mr. G. W. Gale discussed the aeration systems of certain Natal plants. Prof. D. Thodav discussed the genus Passerina and its distribution in South Africa, and Dr. Sim contributed notes on the Bryophyta of Southern Rhodesia. A most interesting paper was contributed by Dr. E. Warren on the interspecific hybrid and back-cross of the foxglove, the paper being followed by a useful discussion. Two papers of special interest to agriculturists were contributed by Mr. E. Parish on agricultural experiment, its design and interpretation, and by Mr. A. O. D. Mogg on a method of veld estimation in relation to lamziekte. There was also a botanical excursion to Isipingo.

In Section D there was a discussion on South African Trematodes, in which papers by Dr. F. G. Cawston on *Bilharzia cercariae*, by Mr. F. W. FitzSimons on birds as possible carriers of snails, and so as distributors of Bilharzia, and by Dr. Annie Porter on experimental researches on various species of Schistosoma and Fasciola were first considered. Mr. J. Sandground gave a detailed account of the life-history of species of Heterodera in South Africa, and Mr. R. H. T. P. Harris described the beetle, *Ortalia pallens*. Mr. E. C. Chubb contributed a paper on the natural history and geology of Durban. Much interest was aroused by the account given by Dr. H. B. Fantham and Miss Esther Taylor of the Protozoa found by them in some South African soils. Dr. Fantham also described his further observations on parasitic Protozoa in animals in South Africa. Dr. Lindsay Johnson gave an interesting account of various methods for screening light observed in the eyes of vertebrates, beautiful lantern slides being shown. There was also a zoological excursion for observations on the animal life of Durban Bay.

In Section E Mr. D. A. Hunter discussed Bantu industries, Mr. W. H. Tooke dealt with natives and agriculture, and Mr. H. S. Keigwin gave an account of an educational experiment. Mr. S. S. Dornan spoke of the heavenly bodies in South African mythology; Mr. W. Wanger dealt with two Ntu problems, and Mr. A. J. Bryant gave an account of some native marriage rites. Prof. W. A. Norton read papers on the regiments of the house of Moshish, Sesuto praises of the chiefs and the Bantu idiomatist, and Mr. D. D. T. Jabavu contributed a paper on Bantu literature.

In Section F Mrs. Mabel Palmer discussed Irving Fisher's proposals for stabilisation of the value of money, and Mr. G. Burgess dealt with the taxation of land values. Mr. C. Graham Botha gave papers on archival problems in South Africa and on the preservation of our national monuments. Dr. J. E. Holloway spoke on decentralisation in university education and research. An interesting paper on the function of a school of art in the life of an urban community was given by Mr. O. J. P. Oxley, who illustrated his remarks by an exhibit.

The next annual meeting of the Association will be held in July, 1922, at Lourenço Marques, under the presidency of Dr. A. W. Rogers. H. B. F.

University and Educational Intelligence.

LONDON.—Dr. R. H. Aders Plimmer has been appointed as from January 1, 1922, to the University chair of chemistry, tenable at St. Thomas's Hospital Medical School. Since 1919 Dr. Plimmer has been head of the Biochemical Department of the Rowett Research Institute of Animal Nutrition at the University of Aberdeen and North of Scotland College of Agriculture, and research lecturer in applied biochemistry in the University of Aberdeen.

Mr. H. H. Dodwell has been appointed as from March 1, 1922, to the University chair of the history and culture of British Dominions in Asia, with special reference to India, tenable at the School of Oriental Studies.

Dr. Lewis Simons has been appointed as from March 1, 1922, to the University readership in

physics, tenable at Birkbeck College. Since 1917 Dr. Simons has been lecturer in physics at the South African College, now the University of Cape Town.

The following doctorates have been conferred: *D.D.*: Rev. W. R. Matthews, an internal student of King's College, Theological Department, for a thesis entitled "Studies in Christian Philosophy." *D.Sc.* (*Chemistry*): Mr. K. G. Naik, an internal student of the Imperial College, Royal College of Science, for a thesis entitled "The Interaction of Sulphur Monochloride with Substances containing the Reactive Methylene Group or Substituted Methylene Group." *D.Sc.* (*Economics*): Mr. Sih-Gung Cheng, an internal student of the London School of Economics, for a thesis entitled "Modern China: A Political Study."

MANCHESTER.—The following appointments have been made: Mr. C. B. Dewhurst, dean of the faculty of science; Dr. J. P. Buckley, lecturer in regional surgery; Mr. J. M. W. Morison, lecturer in applied anatomy; Dr. T. H. Oliver, lecturer in clinical medicine; and Mr. H. S. Leigh and Mrs. Leonore Pearson to honorary research fellowships.

THE honorary degree of Doctor of Science has been conferred by the University of Calcutta on Sir W. J. Pope, professor of chemistry, Cambridge University, and on Prof. C. V. Raman, professor of physics, University of Calcutta.

THE general council of the Trades Union Congress and the executive of the Labour Party passed the following resolution on December 15:—"That this joint meeting views with profound disappointment the apparent intention of the Government further to reduce expenditure on education, and in particular condemns the decision of the Treasury to reduce the annual universities grant from 1,500,000*l.* to 1,200,000*l.*, which can do virtually nothing to relieve the national finances, but which will be a serious blow to higher education."

THE twenty-second annual meeting of the Science Masters' Association will be held in the chemical department of the Imperial College of Science and Technology (Royal College of Science) on January 3–4 next. The president of the association, the Master of Balliol, will deliver his address on January 3, taking as his subject "Science and History." The topics for discussion on the first day of the meeting are The Teaching of Mechanics and The Teaching of Geography in Relation to Science, while Physical Chemistry in Schools and Post-Certificate Science for Non-Specialists will occupy the second day. Exhibitions of apparatus and books by members, instrument-makers, and publishers will be open during the meeting.

THE annual meeting of the Mathematical Association will be held at the London Day Training College, Southampton Row, London, W.C.1., on January 2 and 3 next. The following are among the papers to be submitted during the meeting:—Mathematics in Artillery, by Sir George Greenhill; The Structure of the Atom, by Prof. J. W. Nicholson; Vectors, by Prof. C. Godfrey; The Dalton Plan and the Teaching of Mathematics, by Miss F. A. Yeldham; and The late Srinivasa Ramanujan, by Prof. G. H. Hardy. There will also be discussions on the simultaneous teaching of pure and applied mathematics and on methods of keeping mathematics teachers in touch with modern developments of the subject. Sir Thomas L. Heath has been nominated president of the association for the years 1922 and 1923 in succession to the Rev. Canon J. M. Wilson.

Calendar of Scientific Pioneers.

December 22, 1590. Ambroise Paré died.—Surgeon to four Kings of France, Paré served through many campaigns, doing much to improve the treatment of wounds, especially by the substitution of ligature of the arteries for cauterisation with a red-hot iron after amputation. He is regarded as the father of modern surgery.

December 22, 1722. Pierre Varignon died.—In 1687, the year Newton's "Principia" appeared, Varignon published his work on mechanics based on the composition of forces. Like l'Hospital, he was a powerful advocate in France of the use of the differential calculus.

December 22, 1828. William Hyde Wollaston died.—Abandoning medicine for scientific research, Wollaston made investigations over a wide field and contributed much to chemistry and optics. He first noticed the dark lines in the spectrum, invented the camera lucida and a reflecting goniometer, showed the identity of galvanism and frictional electricity, and discovered palladium and rhodium. By making platinum malleable he gained a fortune of 30,000*l.*

December 22, 1887. Ferdinand Vandeveer Hayden died.—A great geological explorer, Hayden was prominently connected with the survey of the Western States of America and wrote valuable works on natural history and economic science. The idea of the National Park on the Yellowstone River was his.

December 23, 1901. Sir Joseph Henry Gilbert died.—The fellow-student of Lawes at University College, London, Gilbert worked under Liebig at Giessen, and in 1843 began his lifelong collaboration with Lawes in agricultural chemistry. For some years he held the chair of rural economy at Oxford.

December 23, 1907. Pierre Jules César Janssen died.—Janssen was the pioneer of spectroscopic astronomy in France. Well known for his scientific expeditions, in 1868 in India independently of Lockyer he discovered the method of observing the solar prominences in daylight. In 1876 he became director of the observatory at Meudon, and he also established a meteorological observatory on the summit of Mont Blanc.

December 24, 1872. William John Macquorn Rankine died.—Distinguished alike as an engineer and physicist, Rankine from 1855 held the chair of engineering at Glasgow and published standard text-books on various branches of engineering. His "Steam Engine" contained the first systematic treatise on thermodynamics, and he made important researches in molecular physics.

December 26, 1886. Theodor Ritter von Oppolzer died.—Professor of astronomy in the University of Vienna, Oppolzer paid special attention to theoretical astronomy, did valuable work on the European degree measurement, and published a "Canon der Finsternisse" containing the elements of eclipses of the sun and the moon from 1207 B.C to A.D. 2162.

December 28, 1850. Heinrich Christian Schumacher died.—The founder a century ago of the *Astronomische Nachrichten*, thirty-one volumes of which he edited, Schumacher held positions in Copenhagen and Mannheim, and in 1821 became director of the Altona Observatory.

December 28, 1899. Karl Friedrich Rammelsberg died.—Born in 1813, two years after Bunsen, Rammelsberg passed his life teaching and experimenting in Berlin, adding immensely to the knowledge of inorganic chemistry, mineralogy, and crystallography.

E. C. S.

Societies and Academies.

LONDON.

Aristotelian Society, December 5.—Prof. G. Dawes Hicks in the chair.—J. **Johnstone**: The limitations of the knowledge of Nature. A survey of the speculative biology of the late nineteenth and twentieth centuries forces one to the recognition of a twofold passage of Nature. According to the fundamental concept of physical science, the second law of energetics, viz. the augmentation of entropy, physical change tends continually to diminution. The universe, to use Bergson's term, is detending. To the biologist there is another aspect, for life is the incessant attempt of certain physico-chemical systems to resist the increase of entropy. The difficulty in accepting generalised relativity in biology is that for speculative physiology space-time cannot be completely isotropic, especially if we regard the quality of duration as the cumulative continuity of life. It is a passage, as well as the persistence, of that which has passed. We must regard Newton's "ocean of truth" as amorphous in structure. The relations that are to be discovered in it are in it only in the sense that they come into existence with the thought that makes the relation.

CAMBRIDGE.

Philosophical Society, November 28.—Prof. A. C. Seward, president, in the chair.—J. **Gray**: Note on cell-division. The form of a dividing cell is determined by three forces:—(1) The mechanical force exerted by the cell membrane, (2) the surface tension of the protoplasmic surface, and (3) an internal force which elongates the cell along the main axis of the astral figure.—J. M. **Wordie**: The geology of Jan Mayen. The island is entirely volcanic. The earliest lavas are biotite trachytes, which are post-dated by a conglomerate with wind-polished pebbles. No plant-bed nor anything to suggest the date of the earlier eruptions was found. A period of erosion probably took place between the formation of the southern hills and the much later Beerenberg volcano (8350 ft.). Olivine-basalt moderately rich in alkalis is the dominant rock type throughout the island. The latest volcanic outbursts were from parasitic cones near Beerenberg and from near Vogt Crater, some of lava, others of ash; they were recorded in 1732 and 1818. On Egg Bluff there are cracks from which steam still issues. Beerenberg itself has never been active in historic times; its crater, half a mile in diameter, is now ice-filled.—W. S. **Bristowe**: The insect and arachnid fauna of Jan Mayen. Most of the insects and arachnids also occur in Britain, Greenland, Novaya Zemlya, and Siberia. They may have reached the island from Britain and Greenland fastened to birds or sheltered in their feathers, and from Siberia in driftwood. The distribution of the spiders illustrates the theory of an ancient circumpolar fauna. Two species are found at high altitudes in the Swiss Alps, and all occur above 3000 ft. on Scottish mountains; in Jan Mayen they are found almost at sea-level and upwards. Spiders' eggs hatch out at the end of the season, thus avoiding loss of time when the thaw comes. The list includes five spiders, six mites, one tick, eight Collembola, twelve flies, two ichneumons, and a few water creatures.—J. L. **Chaworth-Musters**: The vegetation of Jan Mayen. The vegetation may be roughly divided into three groups: that of the sea-shore, of the bird cliffs, and of the mountains. Of true halophytic plants there are only two, *Martensia maritima* and *Arenaria peploides*. On the bird cliffs grows the most luxuriant vegetation of the island. The most characteristic points are the presence of luxuriant growths of *Taraxacum croceum*, *Saxifraga cernua*, Oxyria, and *Poa flexuosa*. Kœnigia is the only annual of Jan Mayen, and grows in most damp spots amongst cinders. The sandy wind-swept flats, where there is no driftwood, are destitute of vegetation, and there are no water-plants in the lakes. The remoteness of Jan Mayen from neighbouring lands and its volcanic character make the origin of the vegetation a difficult problem. Probably the most likely means for the transport of seeds are the feet of wading birds, which stop at Jan Mayen on their way to and from their breeding-grounds in Greenland.—Miss M. D. **Haviland**: The bionomics of parasitism in certain Hymenoptera. The hyperparasites of Aphides belong to the super-families of Cynipoidea, Chalcidoidea, and Proctotrypoidea. The first of these are internal, and the second and third external, parasites. Double infestations are common among the hyperparasites, and special terms are suggested to define these relationships.—M. S. **Pease**: Note on Prof. T. H. Morgan's theory of hen feathering in cocks.—S. **Wigert**: A problem concerning the Riemann ζ-function.

DUBLIN.

Royal Irish Academy, December 12.—Prof. Sydney Young, president, in the chair.—J. J. **Dowling** and C. J. **Haughey**: The electrification of smoke nuclei from phosphorus. If smouldering phosphorus is exposed to an electric field, the smoke particles are found to assume charges which depend on the intensity of the field. These charges were investigated by three methods, one a visual method, in which the mobilities of the particles were determined by observing the path of the smoke-stream in a vertical air-current when subjected to a horizontal electric field; the others involved a measurement of the electric charge carried by the smoke. The nuclei were found to be of uniform size and display a periodic increase in charge as the field is gradually increased, due probably to the successive addition of electrons. Charges of from one to twenty-five electrons have been so obtained.—J. J. **Nolan**: Ionisation in moist and dry air. The composite nature of the ionisation in moist air has been demonstrated by two methods. The bulk of the ionisation consists of four groups of ions of mobilities approximately 2, 1·8, 1·5, and 1·35 cm. sec. per volt cm. Other groups are present in small quantities, the most notable having a mobility of 12. With extreme drying the faster groups appear in greater quantity, and in the case of negative ions the four ordinary groups disappear. With extreme drying doubly charged positive ions also appear, showing that the act of ionisation by α-rays may involve the detachment of two electrons from the molecule. Evidence is found of the existence of free electrons in air at ordinary pressures.—R. A. P. **Rogers**: The simplest mode of representing a continuous linear orthogonal transformation by means of rotation and translation of a rigid schema in a Euclidean manifold of n dimensions. The transformation in question, with constants added, corresponds to a displacement of a rigid schema in S_n, which may be effected by a unique system of $n/2$ independent rotations, if n is even, or if n is odd by $(n-1)/2$ such rotations together with a unique independent translation. A method of reduction by means of invariants to the canonical form required is given.

PARIS.

Academy of Sciences, December 5.—M. Georges Lemoine in the chair.—F. **Roux**, H. **Vallée**, H. **Carré**, and the late M. **Nocard**: *Résumé* of experiments on aphthous fever. A summary of results obtained since

1901, dealing with the preservation of the virus, fallacies to be avoided in experimental infection, and the possibility of vaccination against the disease.—C. **Guichard**: The infinitesimal geometry of the linear complex.—M. Félix Mesnil was elected a member of the section of anatomy and zoology in succession to the late Edmond Perrier.—G. **Julia**: Meromorphic solutions of certain functional equations.—W. **Loth**: The solution of the problem of the direction of aeroplanes and dirigibles in mist or on dark nights. An application of an electrical method already successfully applied to ships.—E. **Carvallo**: Electromagnetism and the principle of relativity.—M. **de Broglie**: Corpuscular spectra and their utilisation for the study of X-ray spectra.—L. **de Broglie**: The degradation of the quantum in the successive transformations of high-frequency radiations.—G. **Reboul**: A new radiation of short wave-length. In an earlier communication an account was given of some experiments in which a feebly conducting body traversed by a current of electricity gave radiations marking a photographic plate. Further experiments show that the effects are not due to a new type of ray, but to ordinary radiations of a wave-length intermediate between the extreme ultra-violet and the X-rays.—F. **Michaud** and A. **Balloul**: The action of an electric field on an insulating liquid. A discussion of some results recently published by M. Bouchet.—L. **Brillouin**: The propagation of light in a dispersive medium.—A. **Pereira-Forjaz**: The spectroscopic study of a Portuguese meteorite.—A. **Pereira-Forjaz**: The spectroscopic study of some Portuguese tungsten minerals.—G. **Petit**, L. **Marchand**, and L. **Jaloustre**: The general effects of hypodermic injections of thorium-X upon the organism.—G. **Contremoulins**: The *rôle* of metroradiography in the establishment of endoprothetic pieces in dead bone.—E. **Grandmougin**: The intermediate products in the synthesis of alizarin.—P. **Lebeau** and M. **Picon**: The action of sodammonium on pyridine. The preparation of the hydrate of tetrahydrodipyridyl.—P. **Malvezin**, C. **Rivalland**, and L. **Grandchamp**: A new preparation of formaldehyde hydrosulphite and an economical generator of hydrosulphurous acid. Zinc dust is suspended in formaldehyde solution and sulphur dioxide added through the walls of a Chamberland filter; a strong solution of the zinc hydrosulphite formaldehyde is formed.—Mme. **Ramart**: The molecular transposition accompanying the dehydration of 1 : 1-diphenyl-2 : 2-dimethyl-1-propanol.—G. **Denigès** and R. **Tourrou**: The microchemical reactions of dulcine (*p*-ethoxyphenylurea).—A. **Schoep**: Curite, a new radio-active mineral. This mineral was found with chalcolite in the Belgian Congo. Analysis proved it to be a lead uranate of the composition $2PbO,5UO_3,4H_2O$. It is very radio-active, and the name "curite" is proposed for the mineral.—P. **Russo**: The fluvial terraces of Kiss, Sebou, and Ouergha (Morocco).—E. **de Martonne**: The platforms of erosion of the Bihar Mountains, Rumania.—Mlle. Y. B. **de Black**: Researches on the Mindelian epicycle in the high valley of Cère and on the plateau of Lacapelle-Barrez (Cantal).—E. **Eblé**: The periodicity of the microseismic agitation. It is known that seismographs record an almost uninterrupted movement of the earth's surface, consisting of a succession of waves of a period between 4 and 8 seconds and very variable amplitude. A rapid examination of the records of the Parc Saint-Maur Observatory has been made by giving a figure to each hour of the day, indicating by estimation the degree of agitation. The scale adopted was arbitrary, calling calm 0, very agitated 4, analogous to the old classification of stars by magnitudes. Taking a period of ten years a regular periodicity is shown, with a clear minimum in July and a maximum, not so clear, in January or February. There is also a diurnal and a semi-diurnal variation.—J. **Vallot**: The measurement of the influence of heat and light on the activity of reduction by animal tissues and applications to heliotherapy. The experiments show that the therapeutic action of solar radiation is explained by the strong increase of activity of reduction by the tissues which it causes.—P. **Courmont**, A. **Rochaix**, and F. **Laupin**: The rate and rhythm of disappearance of organic matter in the course of the purification of sewage by the method of activated sludge.—R. **Sazerac** and C. **Levaditi**: The action of certain bismuth derivatives on syphilis. Further clinical results have confirmed the remarkable activity of potassium tartarobismuthate in syphilis, and experiments with other bismuth salts are now recorded, including ammoniacal citrate of bismuth, bismuth lactate, bismuth sub-gallate, and bismuth oxyiodogallate. All the bismuth preparations are active against syphilis, but vary in toxic power on the organism. From the point of view of human therapeutics, the tartarobismuthate originally tried is the best.

Books Received.

The Metallurgy of the Common Metals. Gold, Silver, Iron (and Steel), Copper, Lead, and Zinc. By L. S. Austin. Fifth edition, revised and enlarged. Pp. xviii+615. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 42*s*. net.

Comité Spécial du Katanga. Contribution à l'Etude de la Flore du Katanga. By E. de Wildeman. Pp. viii+cxliv+264. (Bruxelles: D. Reynaert.)

Comparative Ethnographical Studies. By Erland Nordenskiöld. No. 4: The Copper and Bronze Ages in South America. Pp. viii+197. (London: Oxford University Press.) 18*s*. 6*d*. net.

The Calendar: Its History, Structure, and Improvement. By Alexander Philip. Pp. xii+104. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Benign Stupors: A Study of a New Mania—Depressive Reaction Type. By Dr. A. Hoch. Pp. xii+284. (Cambridge: At the University Press.) 14*s*. net.

The Provinces of Ireland. Edited by George Fletcher. Munster. Pp. xii+176. Ulster. Pp. xii+186. (Cambridge: At the University Press.) 6*s*. 6*d*. net each.

Town Theory and Practice. By W. R. Lethaby and others. Pp. 139. (London: Benn Bros., Ltd.) 5*s*. net.

Four-Figure Logarithms and other Tables. By G. Hogben. New edition. Pp. 24. (Auckland, N.Z., and London: Whitcombe and Tombs.) 2*s*. 6*d*.

Précis de Physiologie Végétale. By Prof. L. Maquenne. (Collection Payot.) Pp. 175. (Paris: Payot et Cie.) 4 francs.

Forestry for Woodmen. By C. O. Hanson. Second edition. Pp. 238+13 plates. (Oxford: Clarendon Press.)

Synthetic Tannins: Their Synthesis, Industrial Production and Application. By Dr. Georg Grasser. Translated by F. G. A. Enna. Pp. viii+143. (London: Crosby Lockwood and Son.) 12*s*. net.

The Adjustment and Testing of Telescope Objectives. Third edition. Pp. 123+3 plates. (York and London: T. Cooke and Sons, Ltd.)

The Palace of Minos: A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos. By

Sir Arthur Evans. Vol. 1: The Neolithic and Early and Middle Minoan Ages. Pp. xxiv+721+18 plates. (London: Macmillan and Co., Ltd.) 6 guineas net.

Medical Research Council. Reports of the Industrial Fatigue Research Board. No. 12: Vocational Guidance. (A Review of the Literature.) By B. Muscio. (General Series, No. 4.) Pp. 57. 1s. net. No. 15: Motion Study in Metal Polishing. By E. Farmer and R. S. Brooke. (Metal Series, No. 5.) Pp. 65. 2s. net. (London: H.M. Stationery Office.)

Imperial Institute Map of the Chief Sources of Metals in the British Empire, with Diagrams of Production. Prepared under the direction of the Mineral Resources Committee of the Imperial Institute. 35½″×44″. (London: G. Philip and Son, Ltd.) 5s. 6d. net.

Tierpsychologie. By Prof. Dr. H. E. Ziegler. (Sammlung Göschen 824.) Pp. 115. (Berlin and Leipzig: W. de Gruyter and Co.) 6 marks.

The University of Chicago: Publications of the Yerkes Observatory. Vol. 3, Part 3: The Rotation Period of the Sun as Determined from Measures of Plates taken with the Rumford Spectroheliograph. By Philip Fox. Pp. viii+67–204+plates 24–26. (Chicago: University of Chicago Press; London: Cambridge University Press.) 2.50 dollars net.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 7: On the Distribution of Earthquakes in the Netherlands East Indian Archipelago, 1909–1919; with a Discussion of Time Tables. By Dr. S. W. Wisser. Pp. iv+79+3 plates. Verhandelingen No. 8: Het Klimaat van Nederlandsch Indië. (The Climate of the Netherlands Indies.) Deel 1 (Vol. 1): Algemeene Hoofdstukken (General Chapters), Aflevering 1 (Part 1) (With English Summaries). By Dr. C. Braak. Pp. viii+64+18. (Batavia.)

Department of Scientific and Industrial Research. Bulletin No. 5: The Cleaning and Restoration of Museum Exhibits. Report upon Investigations conducted at the British Museum. Pp. 12. (London: H.M. Stationery Office.) 2s. net.

Department of Scientific and Industrial Research: Fuel Research Board. Technical Paper No. 3: The Efficiency of Low Temperature Coke in Domestic Appliances. By Dr. M. W. Fishenden. Pp. 35. (London: H.M. Stationery Office.) 9d. net.

Out West for Thirty Years: Notes of a Ministry in the Real Australia. By the Rev. W. Robertson. Pp. x+191. (The Manse, Hay, N.S.W.: The Author.) 2s.

Die Rätzel des Vogelzuges: Ihre Lösung auf Experimentellem Wege durch Aeronautik, Aviatik und Vogelberingung. By F. von Lucanus. Pp. viii+226. (Langensalza: H. Beyer und Sohne.) 30 marks.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1922. Edited by G. E. Brown. 61st issue. Pp. 820. (London: H. Greenwood and Co., Ltd.) 2s. net.

Catalogue of the Selous Collection of Big Game in the British Museum (Natural History). By J. G. Dollman. Pp. viii+112. (London: Longmans, Green and Co.) 7s. 6d.

Thought-Coin. By Bart Kennedy. Pp. x+219. (London: W. Rider and Son, Ltd.) 5s. net.

Main Counts and Calculations. By T. Woodhouse. (Oxford Technical Manuals.) Pp. viii+119. (London: H. Frowde and Hodder and Stoughton.) 6s. net.

Transactions of the Royal Society of Edinburgh. Vol. 52, Part 4 (No. 33): On Old Red Sandstone Plants showing Structure, from the Rhynie Chert Bed, Aberdeenshire. Part 5: The Thallophyta Occurring in the Peat-Bed, the Succession of the Plants throughout a Vertical Section of the Bed, and the Conditions of Accumulation and Preservation of the Deposit. By Dr. R. Kidston and Dr. W. H. Lang. Pp. 855–902+10 plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 13s.

The Economic Aspects of Geology. By C. K. Leith. Pp. xvi+457. (London: Constable and Co., Ltd.) 18s.

A Treatise of Electro-Chemistry. Edited by B. Blount. The Electro-Metallurgy of Steel. By C. C. Gow. Pp. xvi+351. (London: Constable and Co., Ltd.) 27s. 6d.

The Legacy of Greece. Edited by R. W. Livingstone. Pp. xii+424. (Oxford: Clarendon Press.) 7s. 6d. net.

Diary of Societies.

THURSDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Prof. J. A. Fleming: Electric Waves and Wireless Telephony: Surface Waves on Liquids.

INSTITUTION OF AUTOMOBILE ENGINEERS (at 28 Victoria Street), at 7.30.—Adjourned Discussion on Paper by H. F. L. Orcutt: Motor-car Gear-boxes.

SATURDAY, DECEMBER 31.

ROYAL INSTITUTION, at 3.—Prof. J. A. Fleming: Electric Waves and Wireless Telephony: Waves in Air.

CONTENTS

PAGE

Carbon Monoxide in Public Gas Supplies. By W. A. B. . . . 521
Diseases of the Rubber Tree (*Hevea braziliensis*) By J. B. F. . . . 524
Some Psychological "As Ifs." By C. Ll. M. . . 525
Our Bookshelf . . . 526
Letters to the Editor:—
The Tendency of Elongated Bodies to Set in the East and West Direction.—**Walter D. Lambert** . . 528
Japanese Culture Pearls.—**Dr. H. Lyster Jameson** 528
A Curious Physiological Phenomenon.—**F. C. Dannatt; Prof. T. Graham Brown** . . . 529
Echinoderm Larvæ and their Bearing on Classification.—**Prof. E. W. MacBride, F.R.S.; Dr. F. A. Bather, F.R.S.** . . . 529
Some Problems in Evolution.—**W. R. Bousfield, K.C., F.R.S.; Prof. E. S. Goodrich, F.R.S.** 530
World List of Scientific Periodicals.—**Prof. W. W. Watts, F.R.S.** . . . 531
Old Observations Bearing on the Duration of Sunrise.—**Dr. Willard J. Fisher** . . . 531
The Measurement of Ionisation Currents by Three-electrode Valves. (*With Diagram.*)—**J. C. M. Brentano** . . . 532
Simple Sensitive Flames.—**G. A. Sutherland** . . . 532
The Message of Science. By **Sir Richard Gregory** 533
Integration in the Living Organism. By **Prof. W. M. Bayliss, F.R.S.** . . . 537
"Leader" Cables for Aircraft . . . 539
War Work of the Bureau of Standards, U.S.A. By J. L. H. . . . 540
Obituary:—
The Right Hon. Lord Lindley, P.C., F.R.S. 541
Notes . . . 542
Our Astronomical Column:—
The Markings on Jupiter . . . 547
The Ultra-Violet Spectrum of α Cygni . . . 547
The Origin of the Scottish People . . . 548
An Agricultural Enterprise . . . 549
Optical Wedges. By C. J. . . . 550
The South African Association for the Advancement of Science. By H. B. F. . . . 550
University and Educational Intelligence . . . 552
Calendar of Scientific Pioneers . . . 553
Societies and Academies . . . 554
Books Received . . . 555
Diary of Societies . . . 556